Residential Land Use and Housing Development in Indonesia from the Perspective of Sustainable Urban Form

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Dissertation

Residential Land Use and Housing Development in Indonesia from the Perspective of Sustainable Urban Form

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Abstract

This PhD research targets to find the solution for housing development in Indonesia to achieve sustainable Urban Form through land use control on residential land use. Start from the review on the spatial planning in Indonesia, this PhD dissertation introduces the spatial planning system in Indonesia and its implementation in Surabaya city. Further, we focus on traditional life style, this research attempts to present the adaptability of dwellers to arrange their house. Dwellers tend to adjust their spatial setting in order to accommodate domestic activities. We have studied a settlement area which has kampong characteristics by strong Javanese influence. There are several individual variations and differentiations in the area, especially on the function of rooms and the implications on spatial arrangement. Javanese cultural characteristics are mostly unchanged. This part discusses a study about Javanese perceptions of rooms in the house and their perceptions of the flexibility of the rooms.

The strength of tradition supports the element of stability from one generation to another. In the case of housing pattern where traditions will generally be passed on to the next generation, we use vernacular approach. Tradition is still maintained when utilizing the home as a Home-based Enterprise (HBE). HBE developments are based on a family's economic growth rate and their living needs. In homogeneous houses, it appears that there is vernacular activity in building or repairing homes. As an example, in the case of HBEs, housing activities are maintained during the process of urban growth. Houses need to be expanded according to the needs of livings and business activities within a limited urban area. In this research the pattern of house development based on vernacular HBEs, encompassing both living activities and business activities, has been investigated.

In the scope of Land Use Zoning (LUZ) is necessary to control the housing development in residential use. In the case of The LUZ in Indonesia, there is not enough categories in determining the different types of land use for residential use. Due to the housing development, the urban sprawl taking place in fringe areas has rapidly increased. It leads the problems of despairing rural housing and decreasing production of natural resources due to social inequality in the rapid development process. Therefore, in achieving a sustainable urban form, this project is conducted with zoning review in the border area, especially in the area that contains the project-based hous-

ing and home owner-based housing. The existing zoning does not distinguish between project-based housing development and home owner-based housing development. A clear line between different types of residential use is suggested in order to provide a basis for planners and developers in the construction of project-based housing without disturbing the home owner-based housing for a sustainable urban form.

Keywords: Boundary, Depth Ratio, Housing Pattern, Javanese House, Land Use Zoning, Life Style, Residential Housing Development, Spatial Planning, Spatial Arrangement, Sustainable Urban Form.

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Chapter 1 : Introduction

In developing countries, the housing development has problems caused by the lack of proper planning. The one of issue in urban planning is sustainable urban form. In term of spatial planning, we introduce the practice of Spatial Planning in Indonesia on the aspects of urban planning and design related to the natural resource and sub-urbs preservation efforts. This research focus on the residential housing development regard to Sustainable Urban Form starts from lifestyle in a house that is influenced by tradition, next manifested in the determination of the pattern of house development that are also influenced by the tradition that runs from generation to generation. This research will also consider the need to maintain home owner-based housing development that need to be given a clear line for the project-based housing development. This dissertation is the research result on study about the implementation and development of housing in Indonesia, with a case study in Surabaya city, Sidoarjo city, Malang city, and Yogyakarta city, Indonesia.

1.1 Background

Focus on owner perception to improve their house by room's flexibility, commonly Indonesian people build their own house gradually and reflecting behavioral occupying of dwellers. This dissertation also attempts to present about adaptability of dweller to arrange their house. The dweller tends to adjust their spatial setting in order to accommodate domestic activities. In this case, the housing development needs to maintain the specific regulation of the palace as a representative of Javanese Culture. The research took place at a settlement which has kampong character. There are several of individual variability and differentiation on that area, especially on function of room and the implication on spatial arrangement.

Furthermore, in the case of home owner-based housing, the owner needs the process of building and maintaining their houses. Almost Indonesian people use the strength of tradition to support the stability from one generation to another. It shown that group of people in the urban area maintains their traditions to the next generation. Tradition is still maintained when utilizing the home as a Home-based Enterprise (HBE). HBE developments are based on a family's economic growth rate and also

consider their household needs. In homogeneous houses, it appears that there is vernacular activity in building or repairing homes. As an example, in the case of HBEs, housing activities are maintained during the process of urban growth.

Further, in the context of residential area, the home owner-based house expanded by the project-based housing development. Home owner-based house needs to be sustained in order to achieve the desired urban form. In the context of city planning, residential areas cannot be separated from the Land Use Zoning (LUZ), because it necessary to control the urban land use. In the term of LUZ in Indonesia, there are not enough categories in determining the different types of land allotment for housing use. Due to the housing development, the urban sprawl took mostly place in fringe areas. In achieving a sustainable urban form in urban fringe, this research is conducted with zoning review in the border area, especially in the area that contains the project-based housing and home owner-based housing.

1.2 Objectives

Based on the problems above, this dissertation has some objectives to give the solution, there are:

1. Determining on flexibility of rooms to support housing development and explain the decision of spatial arrangement in the house in the urban area.
2. The pattern of house development based on vernacular HBEs Houses need to be expanded according to the needs of living and business activities within a limited urban area.
3. A clear line between different types of residential use is suggested in order to provide a basis for planners and developers in the construction of project-based housing without disturbing the home owner-based housing for a sustainable urban form.

1.3 Literature Review

1.3.1 Residential Housing Development

A settlement is a residential place of activities that support human life. According to Newmark and Thompson (1977) and Silas (1993) about the terminology of house as shelter, house, and home; According to the function of the house is not just for shelter, rest, and family (residential), but it also can serve as a mobilized resource for

the occupants. According to Ferguson and Smets (2010), Bredenoord and Lindert (2010), and Abbot (2002a), resources dedicated to incremental housing have to compete with other needs of the household. In addition, Sarwono (1992) states that humans will always adjust the environment by considering the feasibility elements for human habitation which are related to human needs. On the other hand, Samadhi (2004) said, the norm is also a consideration in determining the direction of house development.

Furthermore, some studies about several aspects to discuss about housing improvements such as: (1) Low building quality and slow development in the process of construction of the house. (Kowaltowski (1998); Bredenoord and Lindert (2010); Abbot (2002a); Abbot (2002b); Ferguson and Smets (2010); Shiferaw (1998); Al-Naim and Mahmud (2007); Kigochie (2001); Sullivan and Ward (2012); Tipple (2004)), (2) The ability and motivation of households to improve their house (Kellett and Granham (1995); Ghafur (2002); Gough and Kellett (2001); Mukhija (2001)), (3) The symbiotic connection between house and economy, such as HBEs (Onyebueke (2001); Sinai (1998); Coen, Ross, et al. (2008)). (4) The concept of housing (Turner (1972))

Focus on life style to the housing development, Supriyadi, Sudarwanto, et al. (2012), Ahmad, Sultan, et al. (2002). and Anggraini (2012), discussed about lifestyles and increasing households from the original family size were taken into consideration This research also study on the process of generating the spatial configuration and vernacular characteristics regard to Boutabba and Farhi (2011), Aziz and Shawket (2011), and Rapoport (1969).

In deep study about the flexibility of rooms, we use space syntax graphs which focus on discussing spatial arrangement by Anggraini (2012), Omar, Endut, et al, (2011), Boutabba and Farhi (2011), (Dawson (2002), Jeong and Ban (2011), and Kigawa (2003).

1.3.2 Sustainable Urban Form

According to Agenda 21 for Indonesia (1997), housing and settlement development goals are to support economic activity in a coherent system that ensures the preservation of the carrying capacity of the environment and natural resources, so that

all layers and segments of society that grew and evolved by these activities are embodied in settlements which support sustainable qualities.

To achieve sustainable urban form we adapt some studies about spatial pattern of human settlement by social norms and cultural setting (Nunta and Sahachaisaeree (2012)), transformed in line with the modern community (Saleh (2000); Saleh (2001)), and from the view of behavior and satisfaction of living (Marmot (1983), Lewis (1997), Chuo and Lee (2011), and Wang and Chien (1999)).

Discussion on sustainable urban form also focused on city planning, by providing clear boundaries for project-based housing development through land use plan as a tool of urban planning could control the provision of land and buildings (Mark and Goldberg (1986), Assche and Djanibekov (2012), Haughton (1997), Magliocca, McConnell, et al. (2012), Wu and Webster (1998), Grieson and White (1981), Wallace (1988), and Borges, Fragoso, et al. (2010). We also study about urban fringe that is expanded by urban sprawl (Yokohari, Brown, et al. (1994); Haregeweyn, Fikadu, et al. (2012); Amsalu, Stroonijder, et al. (2007) Nellis and Maca (1986); Tai-Yang, Xian-Jin, et al, (2011); Saint-Macarya, Keil, et al, (2010); Zhang (2001); Zhao (2010); Lestrelin (2010); Aguilar and Santos (2011); Gennaio, Hersperger, et al, (2009); Poelmans and Rompaey (2009)) and the effect of project-based housing development (Tse (2001); Sullivan (1984); Weaver and Lawton (2001); Shahraki, Sauri, et al. (2011)).

Understanding both project-based housing development and home owner-based housing condition are important to know the pattern of land cover and land use changes and their environmental and social implications on spatial planning (Lopez, Boccoa, et al. (2001); Firman and Dharmapatni (1994); Firman (2002); Firman (2004)). Land cover were influenced by historical land, protected area management, land use histories, local culture, affordability, the socio-economic conditions and community involvement are important in understanding land cover change (Muriuki, Seabrook, et al. (2011); Sivam (2002)).

1.4 Research Method and Thesis Organization

In the beginning, we start to introduce the spatial planning in Indonesia, from here it will be give first understanding about spatial system in Indonesia and its regulation related to the land use zoning. Then, we study the effort of the city facing

the problem about global warming. This is important knowing how a city effort on its planning can preserve natural resource to achieve sustained urban form. Next, this PhD research focused on the problems like life style, spatial arrangement, vernacular pattern of house development, determining clear line between project-based housing development and owner-based housing development.

First, to consider about room`s flexibility, This PhD research approach was using space syntax method by graph-based theory to examine how the spatial layout of house. For this study, it is first necessary to determine the depth of the Basic Javanese House and then calculate the depth of Javanese houses that exist at the sites (research conducted in Yogyakarta city).

Secondly, we conducted the vernacular studies to deal with requirement such as sustainability. Because this housing is homogeneous, the considerations for the new construction of the house are similar (research conducted in Malang city). To capture the aspects that result in this similarity, questionnaires to residents were used as an investigative tool for data collection. This investigation took aspects of the tradition, business processes, and living activities into consideration.

Finally, conducted review for effects of LUZ on housing development. The sampling was taken in the border area of Surabaya and Sidoarjo. Data took from the local government documents, housing developers, and Tambaksumur village officers. The field data took from the interviews and photos are able to map out the situation there. The steps in this research is to conduct a review of the implementation of LUZ in Indonesia and later explored more in the application of land use zoning in border cities of Surabaya and Sidoarjo.

The research results are the formula to determining flexibility of particular rooms in order to understanding the relationship between space requirements and cultural phenomena is needed, the pattern of house development, and Co-existing Dividing Line (CDL), CDL on LUZ is effective in achieving co-existing development on border area.

The whole research is organized in to 5 Chapters. We started from Chapter 1 for Introduction and following it we will introduce the residential housing development in Indonesia from the perspective of sustainable urban form we mentioned in introduction part. They are, respectively, Chapter 2 about City Planning of Indonesia for Natural Resource and Suburbs Preservation Efforts; Chapter 3 about The Spatial arrangement based on the Javanese tradition to determine the flexibility of the room;

Chapter 4 about Vernacular Pattern of House Development on Home-based Enterprises; Chapter 5 about The Effect of Land Use Zonings on Housing Development in Indonesia; Last, we make a conclusion on this PhD research in Chapter 6.

Chapter 2 ：City Planning of Indonesia for Natural Resource and Preservation Efforts

This chapter aims to introduce the spatial planning in Indonesia and review the planning practice in Surabaya city from the concept of green city design approach, which is recognized as one of planning measures to anticipate problems of global warming that becomes a comment discussion in urbanization process across the cities in the world. The study was conducted by analyzing the designs of Long-Term Development Plan of 2005-2025 and Spatial Planning of Surabaya 2009- 2029 (Hereafter Surabaya's development plan). We are concerned with the aspects of urban planning and design related to the natural resource and suburbs preservation efforts, as well as consistency between development policies in urbanization process in Indonesia.

2.1 Introduction

Republic of Indonesia is the largest country in South East Asia which has more than 17,500 islands (*Figure 2-1*). There are about 6,000 inhabited islands in an area of about 700,000 square kilometers (38% of total land area). Population of Indonesia is the fourth largest country in the world after China, India, and the United States, the unbalanced population where about 70% of the Indonesian population lives in Java (6% of the land area).

Figure 2-1 Map of Indonesia

Source: Ministry of Land, Infrastructure, Transport and Tourism, Japan (MILT (2008))

2.2 Spatial Planning System

Indonesian Government is composed of 34 provinces, 511 in cities levels (414 cities and 97 counties) and 79,702 villages. At each level of local government has the authority to regulate their respective regions (social and economic) in accordance with the National Development Planning System Law (Law No. 25/2004) and spatial planning in accordance with the Spatial Planning Act (Act No. 26/2007) , then any development in this country based on plans have been made in each area.

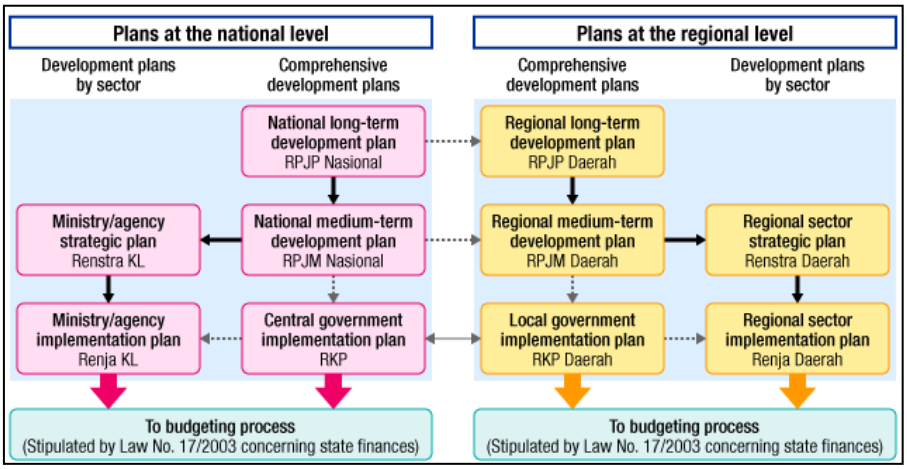


Figure 2-2 Socioeconomic Planning System.

Source: Ministry of Land, Infrastructure, Transport and Tourism, Japan (MILT (2008))

Indonesian state in conducting socio-economic planning at the national level consists of a long-term national development plan (20 years) and five-year development plan; it is also reinforced by the national medium-term development plan and annual plan, each development planning in Indonesia under the supervision of the National Development Planning Agency (BAPPENAS). Future long-term national development plan is based on Law No. 17/2007 (2005-2025), and the medium-term plan (Presidential Decree No. 7/2005) is 2004-2009 (MILT (2008)) (*Figure 2-2*). The purpose of the long-term development plan is to realize the vision, mission, and direction of policy development for a period of 20 years.

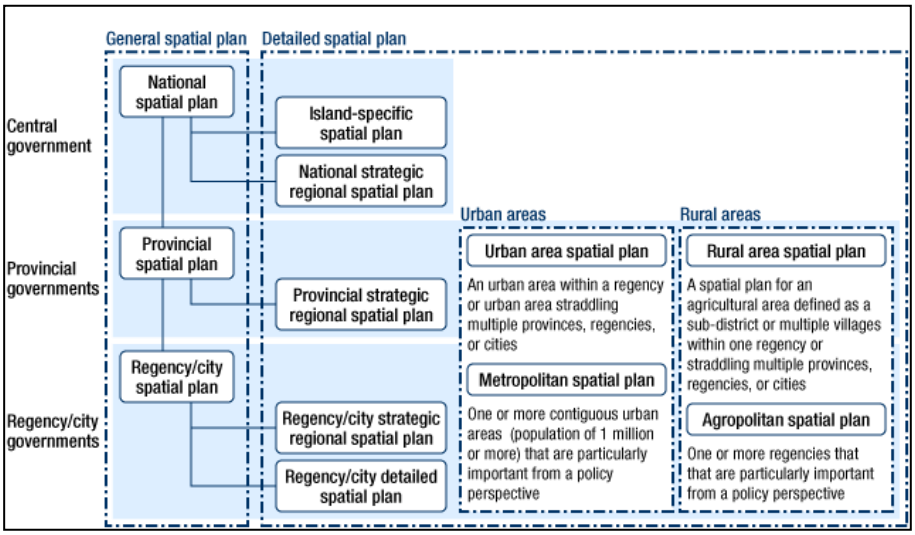


Figure 2-3 Spatial Planning System.

Source: Ministry of Land, Infrastructure, Transport and Tourism, Japan (MILT (2008))

Spatial planning of Indonesia using basic law no.24/1992 (Law on Spatial Planning), further legislation was renewed in 2007 in the context of decentralization, urbanization, and other factors (Law No.26/2007) (*Figure 2-3*). To keep on the track, then subject to review every five years, Indonesian national spatial plan approved by Law No. 26/2008 on Spatial Planning (20-year period) (MILT (2008)). The agency that handles the preparation of the plan is the National Spatial Planning Coordinating Agency, which is chaired by the Coordinating Minister for the Economy. This office was established at the National Development Planning Agency (BAPPENAS) and led by BAPPENAS director. Later in monitoring its implementation, the Directorate General of Spatial Planning Ministry of Public Works is responsible for the implementation of these plans. The implementation of the plan includes guidelines for the effective and efficient planning to achieve goals according to a predetermined plan.

This is also reinforced by the development of a strategic framework for the purpose of creating a national land strategy. The purpose of the framework is to achieve security, economic feasibility, and sustainability in land use of Indonesia, in addition to compactness and stability.

2.3 Green City Design Approach for Global Warming Anticipatory

The increasing number of the world's urban population will increase very significantly. According to Schell and Uljaszek (1999) about 67% of the world's population is expected to live in cities by the year of 2025. Urban development is a logical consequence of the urbanization process. The following effect of urban population growth is the increasing number of physical facilities and rapid development of the city; Due to rapid urbanization, natural ecosystems progressively replaced by urban land use (Li and Wang, 2003a).

In general, economic growth has been contributed to the excessive exploitation of natural resources, which encourage the increase of environmental degradation in both urban and rural areas. The rapid development of the developing countries will fasten global warming and exacerbate resource problems (Murota and Ito, 1996). Increasing energy consumption is the consequence of the distribution and transport inefficient that encourages increasing carbon emissions, in which triggered the greenhouse effect, increasing geothermal and surface waters, which ultimately leads the climate changes. Based on the data from the International Energy Agency during 2002-2007, it is predicted there will be an increasing number in electric energy demand and carbon emissions in Asia and the world until the year of 2030.

Global warming is a phenomenon in which the global temperature increases from year to year due to the greenhouse effect due to higher emissions of carbon dioxide gases (CO2), methane (CH4), Nitrous oxide (N2O) and so on. The phenomenon of global warming which leads to climate change has very serious effects toward human life. Intergovernmental Panel on Climate Change (IPCC) states that the Earth's temperature has been rising up 0.15 - 0.13^{o} C since 1990 to 2005. If the condition remains the same, it is predicted that the Earth's temperature will rise at around 4.2 ^{o} C by the year of 2050 to 2070. It will cause the rising of the sea levels to 90 cm higher than today. In addition, this condition will make around 2,000 small islands will sink. Global warming is a serious threat to coastal cities such as Jakarta, Semarang and

Surabaya. Urbanization leads the decreasing of the capacity; due to the decreasing numbers of open space area in the city, which has an ecological function. Urbanization also leads to the increased number of vehicles that implies the increase of CO2 and CO gas into the air (Murota and Ito, 1996). Exhaust emissions released by vehicles causing major pollution and it is one of the causes of Global Warming.

On the other hand, the provision of green space in the city can be one of the planning measures for the realization of more human-urban environment, and capable of functioning ecological city. Republic of Indonesia mandated Act 26 year 2007 and concerns about the utilization of space that requires 30% green space from the total area of the city. Meanwhile, Indonesia as a maritime country with more than 70% of the territorial waters (coastal, river, and lake) has a challenge and a great potential to save the waterfront area as a buffer zone and conservation of natural environment. Institutions would need a handler to remain subdued conservation function along the waterfront area. The current condition that occurs is the utilization of an increasingly waterside area that is out of control, both in quality and quantity. Actually, the existence of the waterfront area can be optimized as a potential part of green city design through the concept of waterfront as well as substitution of Green Open Space area (Respati, 2004).

2.4 Green City Design

Some research reports talk about green city design for global warming anticipatory basically from the concept of open space, green city, pollution, and sustainable city, such as Dyer (1994), Li, et al. (2005), Li and Wang (2003b), Bradley (1995), Shafer (1999), Diamantini and Zanon (2000), L'utz and Bastian (2002). Generally, city planning and design is an integrated form of physical intervention, which involves socio-cultural, economic and political unity of urban spaces. Thus, the city is a design product in which urban policies are set out in the framework of spatial arrangement of land use as a solution to urban problems in resource utilization (urban space), as well as the linkages between various urban functions in accordance with the necessary infrastructure capacity (Respati, 2004). Furthermore, the aspects of an effective utilization of an urban open space are a primary consideration, such as how aspects of city life (natural and socio-economic) can be accommodated in the spatial structure. The role of urban planning and design in anticipating the impact of global

warming become extremely important in order to protect and create a comfortable living environment and healthy communities through green city design. Some authors stated that, the planning and management of urban green space development is essential to urban sustainable development (Miller, 1988; Grey, 1996). Urban planning and design decisions have a very strong impact on overall physical context, so that deciding the form of the plan must go through a comprehensive consideration.

As an integrated management tool of urban areas, urban design basically aims to promote the formation of urban regulation that is able to anticipate all aspects of urban development including the impact of global warming. It is also a solution for the constraints of natural and artificial environments. According to Shirvani (1985), in his book The Urban Design Process, urban design is a part of the planning process relating to the physical design of urban space and an environment dedicated to the public interest. When viewed from the city-forming element, it's essentially the substance of urban design that actually involves three main elements, they are:

1. Natural environmental factors; natural characteristic is the basic element that will provide the specific characteristics of a region / city. Control of utilization of the natural environment will be crucial in designing the urban environment while ensuring the ecological functions of urban neighborhood to remain alive. These natural factors include: climate, topography, seism city, geomorphology, humidity, air temperature, flora and fauna and so on.
2. Artificial environmental factors, the condition of artificial environment potency as a product of cultural communities that have formed a specific environment which should be a consideration as a whole activity product of society.
3. Non-physical environmental factors, socio-cultural, economic, political, and technological, as a background for the formation factor of human built environment.

Those three factors are a unity that influences each other. The natural environment will determine the structure and patterns of specific cities, as a reflection of patterns of behavior and socio-cultural values, economics and politics behind them (Shirvani, 1985).

Planning green spaces is one of the signs towards sustainable urban development (Teal, et al., 1998). Green open spaces can increase the urban environment, which provide help to public health and increase the quality of urban life (Thompson, 2002). The concept of green city design as a form of micro-city neighborhood becomes a

global issue now. Green City in the Environment World Days in 2005 is used as a central issue in an attempt to save the environment from global warming. Green City is a response towards urbanization in big cities of the world, which has led to the carrying capacity of an urban environment that is in very poor conditions. Green City is conceived as an answer which puts its' emphasize on aspects of environmental sustainability considerations in solving urban problems. Urban green space is an essential component of the urban ecosystem (Li, et al., 2005). Farmlands is one of main types of urban green space, which has significant ecological. (Bradley, 1995; Shafer, 1999; L'utz and Bastian, 2002).

Furthermore, green city design is closely associated with the presence of the urban landscape. The urban landscapes as the embodiment of a role entity is functioned to ensure the sustainability of ecological functions of the city. According to Li, et al. (2005), "*Landscape ecology is the study of the interaction between landscape elements. Landscape ecology resulted in an understanding of how the spatial patterns affect the ecological processes*". The main principle of green city design is essentially about urban design efforts by creating an environment that ensures ecological functions of the city. It is also shown by the experience of several cities in the world in an effort to rescue the city environment. Learning from the experience of several countries about the efforts to save the environment should not be done by extreme huge finance, where are successful in the quality improvement efforts in a sustainable environment by maintaining a balance among economic, social and environment in an integrated and sustainability. Here are several successful environmental rescue efforts:

1. In the spirit Mottai-Nai in Japan has successfully implemented the movement of 3Rs (Reducing, Reusing, and Recycling) in an attempt to preserve the environment. Mottai-Nai is a spirit of living habits or behavior that respects and maintains the product by recycling. Japanese Environment Minister in 2003-2005 periods applies that spirit through movement Nai Mottai-3R (Reducing, Reusing, and Recycling) by reducing the waste, reusing old items, and recycle materials that is recyclable.
2. In Switzerland, they have developed a roof garden. The roof of the house used as part of the environment. Make the roofs a green land by planting various crops. Additionally rooftops also developed to absorb solar energy, which is used as a power source, while still laid some green plants underneath.
3. Bogota mayor in 1998-2001 period, Enrique Penalosa implement the Transmilenio programs, high car taxes, tree planting, 1000 redevelopment of parking, bike lanes

along the 374 km, and the pedestrian along 17 km. People can congregate in public spaces such as streets and city parks where all people have equal rights. To build a humanist or city ciudad Humana is appropriate if the users of bicycles and pedestrians should be pampered. For example, Bogota, before there is a special bike lane, cyclists are 4% only. But after there is a special line for bikes, within five years it has risen to 14 percent of total trips by using bicycles. If the available public transport is safe, convenient, punctual, provided a special bike track, safe pedestrian facilities and comfort, then people will choose the facility as a third mode of transportation rather than private car which can stuck in traffic for hours on the road and waste fuel.

Green city design can ensure the ongoing ecological functions of the city, because of the availability of urban adequate green open spaces or within a relatively large proportion. Formal regulations in Indonesia bring the proportion of urban green open space in the Law of the Republic of Indonesia on Act No 26 year 2007 on Spatial Planning, which sets a minimum of 30% green city open spaces of the total city area. Provision of open space that a city can do is through the utilization of demarcation along the river watersheds, beaches, reservoirs, utilization roof garden, as well as planning and design of open spaces other cities.

Implementation of green urban design in Indonesia is still facing very complex issues, including socio-cultural problems, economically and politically. Substantially, products of city planning and design in Indonesia have not fully made the issue of global warming become a strategic issue. The main orientation of urban planning and design (Shirvani, 1985) of products is still dominated by the orientation of the economy (development orientation), in addition to the orientation on environmental sustainability (environmental orientation) and in the interests of the community (community orientation). In the following section, we review the Surabaya's development plan for understanding how the concept of green city design can be put into planning practice in Indonesia.

2.5 Surabaya`s Development Plan and Urbanization

2.5.1 *Case Study City*

This case study city is Surabaya as the second largest coastal city in Indonesia. In the National Long Term Development Plan, Surabaya is designated as the National

Development Center of eastern Indonesia. Therefore, it is very interesting to know how the planning and design of Surabaya in addressing the current global warming Issues.

As shown in *Figure 2-4*, Surabaya is the capital city of East Java province, which has a geographic position at 07 021 'south latitude and 112 036' to 112 054 'East longitude, with its boundaries described as follows:

- Northern frontier: Madura Strait
- Southern boundary: Sidoarjo regency
- Western frontier: Gresik regency
- Eastern Boundary: Madura Strait

The study was conducted by analyzing the designs of Long-Term Development Plan of 2005-2025 and Spatial Planning of Surabaya 2009- 2029, in which we are concerned with the aspects of urban planning and design related to the environmental preservation efforts, as well as consistency between development policies.

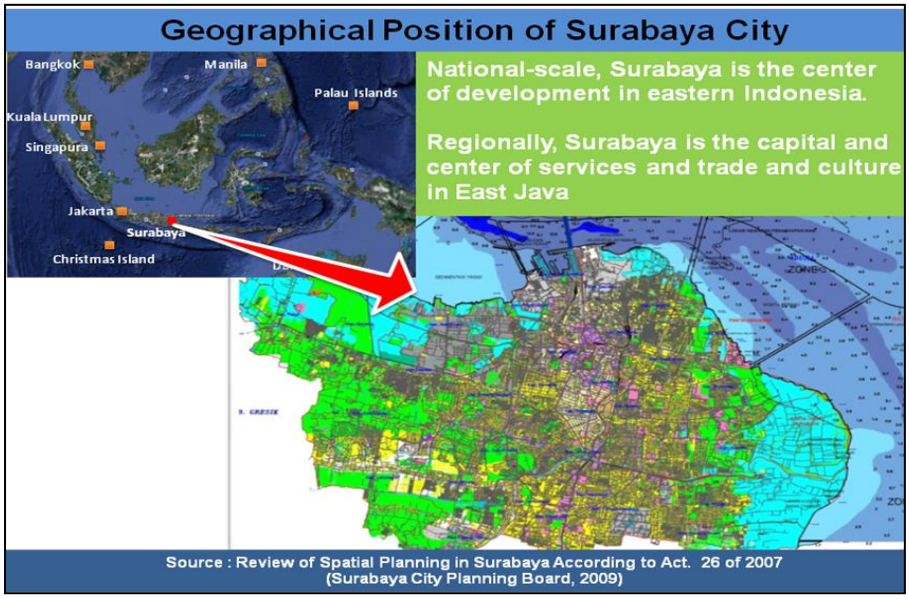


Figure 2-4 Geographical position of Surabaya city as Case.

2.6 Urbanization in Surabaya

Regarding land use utilization and environmental conditions, indication of compliance on Surabaya's Development Plan looks at the suitability of different types of land uses and public facilities. Based on the data analysis of Surabaya long-term planning, extensive land is used for the settlement of ± 12184.71 Ha. The need for residential land in Surabaya will reach approximately 13553.36 hectares or 41.01% of

the total land area of 33 048 hectares. The total housing land requirement is expected to accommodate about 556 542 housing units. So that the needs of residential land is estimated for the year 2029 about 1368.66 acres use of land for public facilities (educational, health, worship, government, culture and recreation) reaches ± 7.718% or 2550.58 Ha. Commercial activities (trade and services) are expected to reach approximately ± 7.721% 2551.76 Ha of the total area of Surabaya city. Industrial and warehousing activities are estimated at ± 3264.92 hectares or 9.879% of the region consisting of the Industrial and Warehouse industry and households scattered in the city of Surabaya. Special area of activities (military) is expected to reach 771.13 Ha or ± 2.33% of the total area in Surabaya city. While the area is built, which was directed in the form of a green open space (protected areas, parks, sports facilities and grave yards) is estimated at ± 7481.35 hectares or 22.638% of the city. Wide roads of 2512.39 hectares or 7.602% and the river reached 362.51 hectares or 1.097%. This condition suggests that the city of Surabaya will experience rapid growth where land-use estimates for each designation tends to increase along with the population growth. Uncontrolled numbers of migrants increased in Surabaya city which can lead to the emergence of solid areas and slums in the city center, near the coast, on the railroad and along the river border. Urbanization will have a negative impact if the development efforts can't be controlled. Mobility of commuters each day to Surabaya has contributed in creating a point of congestion in the streets of Surabaya during the work hours. The use of mass public transit systems and inter-mode system that connects the center of activity is expected to reduce both traffic density and congestion due to commuter mobility, and internal mobility of citizens of Surabaya city. Utilization of the railway line to parse downtown congestion in the city center would be optimal.

Furthermore, the socio-cultural gaps as a result of urbanization will confront the government of Surabaya within the next 15 years associated with the demographic problem is the increasing number of population (*Fig. 2-5*), mainly for the productive age (15-64 years), the implications of which require an increase in the fulfillment of educational facilities, health and expansion of employment and business opportunities. Increasing the number of migrants as a result of successful development, particularly in education will bring socio-cultural issues that must be anticipated to social vulnerabilities that always accompany the development of metropolitan cities.

Progress and development of the city of Surabaya will bring even higher attraction for the community in Surabaya. It is difficult to avoid urbanization so that unemployment will rise. If this is not anticipated by implementing various control measures of urbanization, population growth and expanding employment, the problems will be very complex.

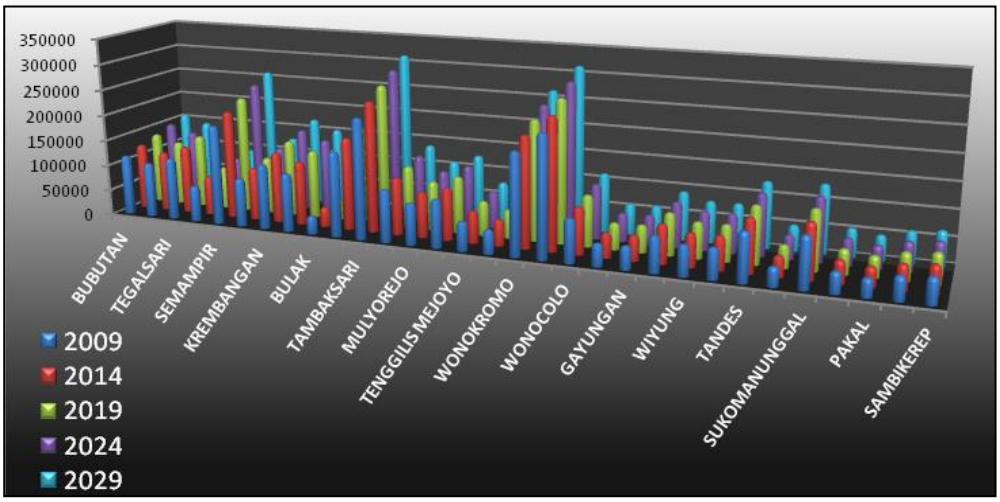


Figure 2-5 Graph of Surabaya Population Prediction per Sub Region.

2.7 Planning Issue in Urbanization Process

Surabaya's development plan attempts to find solutions of various planning issues in its urbanization process. Integrated spatial patterns between the city center (urban) and the suburbs (suburbs), between Surabaya with the surrounding area, supports the function as service centers in Surabaya Metropolitan Area context and Germakertasusila (Gresik, Madura, Mojokerto, Surabaya, and Sidoarjo Regency). As an indirect result of the high intensity of land use, the conversion of land can't be avoided. The challenge is the increasing conversion of agricultural land use or land change function of cultivated area. Zoning for urban green space is largely determined in the Eastern region city of Surabaya (*Fig. 2-6*).

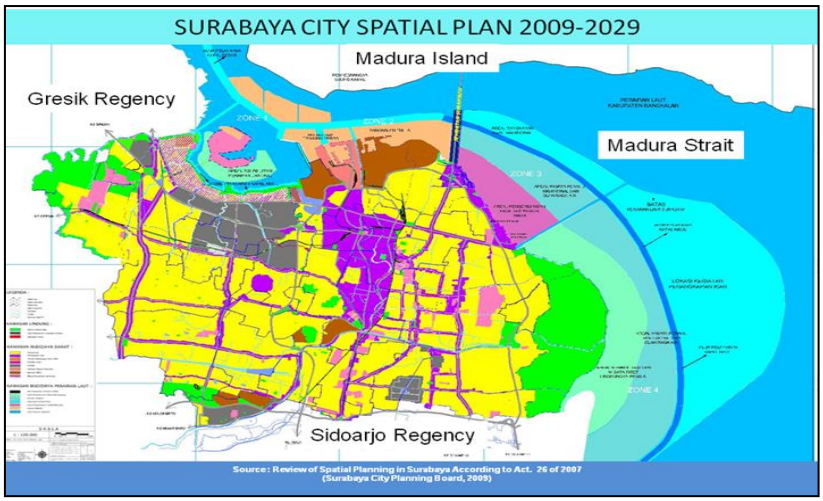


Figure 2-6 Surabaya City Spatial Plan 2009-2029.

(Source: Surabaya City Planning Board, 2010)

The high dynamics of the city of Surabaya developments resulted in a high intensity of land use in Surabaya downtown. This led to the economic value of land that is increasing. The high economic value of the land encourages utilization of services trade both urban and regional scale (*Fig. 2-7*). Yet, the increase in the economic value is also an impact on the utilization of open spaces to green open space of diminishing returns. Current percentage of green space compared to the overall size of the city is 20.84% according to Surabaya City Spatial Plan 2009. Average building density is high (more than 50 buildings / Ha).

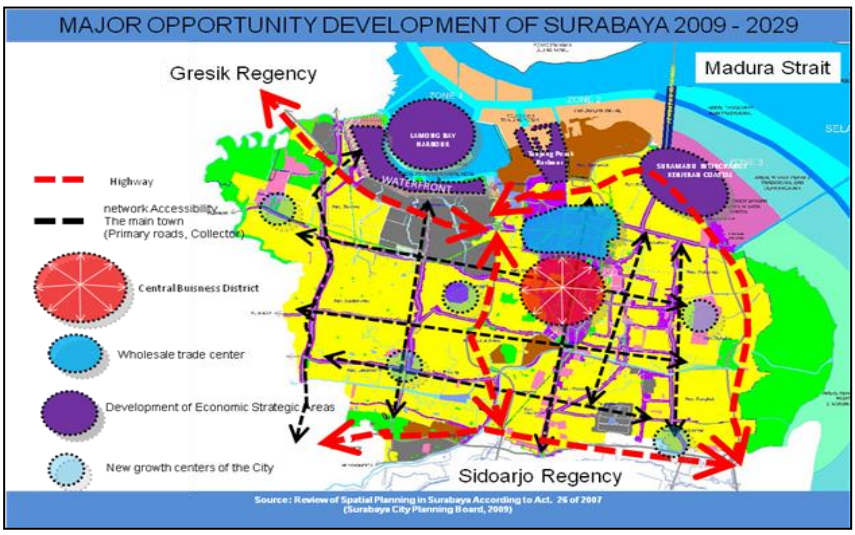


Figure 2-7 Major Opportunity Development of Surabaya 2009-2029.

(Source: Surabaya City Planning Board, 2010)

Several projects should be done is to protect the area along the riverbanks Kalimas. The river is very important to keep the city from the threat of flooding; it must have to be revitalized in order to function properly (*Fig. 2-8*). Surabaya is a coast city, so the

waterfront area should be maintained properly. East Surabaya region needs to be developed for the green barrier, mangrove reforestation, and keep the area from tidal waves (*Fig. 2-9*).

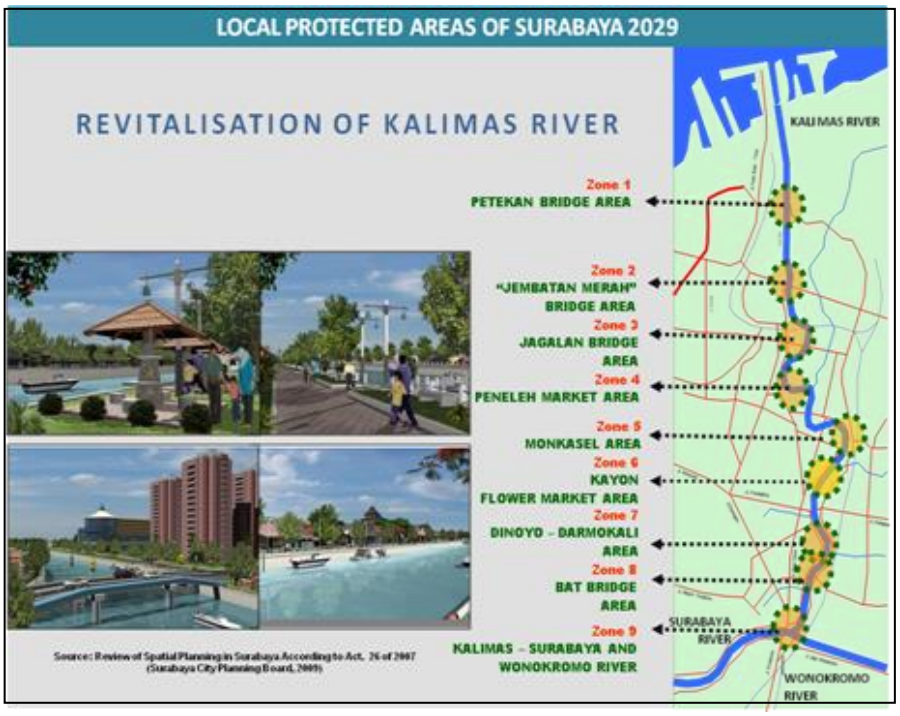


Figure 2-8 Local protected Areas of Surabaya 2029 (1).

(Source: Surabaya City Planning Board, 2010)

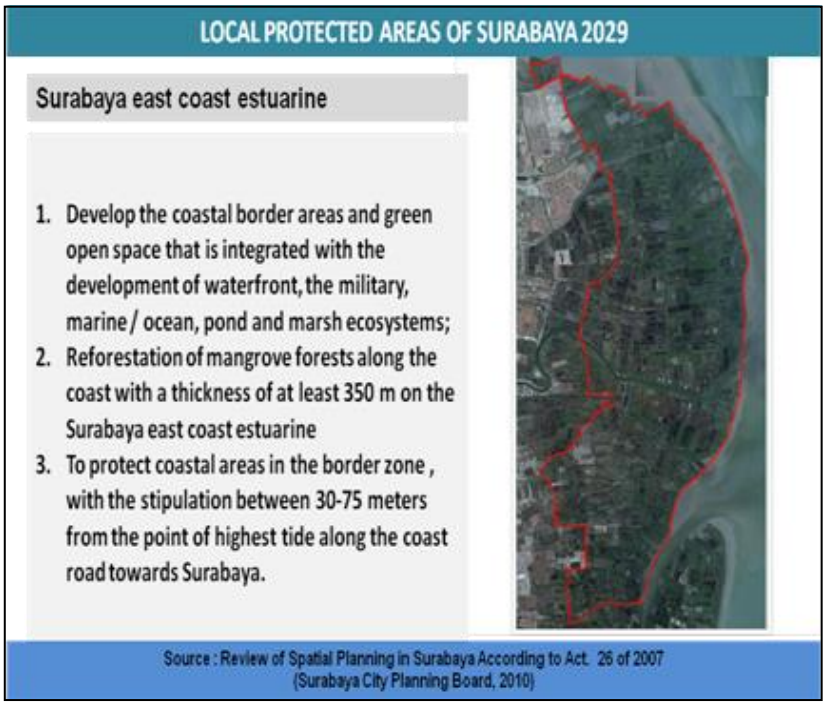


Figure 2-9 Local protected Areas of Surabaya 2029 (2).

(Source: Surabaya City Planning Board, 2010)

Until 2025, the city of Surabaya faces the problem of life quality in its urbanization process. Quality of life of a region is influenced by complicated factors including health, education, security, economics and so on, which are multidimensional, not just about the size of income. Various measures of empowerment, care, rehabilitation, and social protection to vulnerable communities including the social welfare problem have been done, however, the number of social welfare problems are not diminishing in number. The problem of poverty in the city of Surabaya is still a threat that needs to be handled carefully and seriously.

Beside of those issues regarding land use pattern and life quality, statistics have a tendency to decrease the incidence of fire, because there are many sources of water that can be taken to extinguish the fire. Water resources are one of the taken advantages of unused land that is not supervised and not be used, which is precisely also trigger the emergence of illegal settlement.

2.8 Green City Design in Ecological System of Surabaya

2.8.1 *Ecological System*

According to Diamantini and Zanon (2000), the new ecological indicators should be developed for urban planning for sustainable development. Comparison between the areas of green open space can assess the quality of urban planning, although it can't reflect the quality of green open space. As the research conducted by Dyer (1994), he stated that the limits of various plant species can change dramatically due to climate warming, triggered by the release of greenhouse gases in the future. In this case, Surabaya City is a center of the Eastern Indonesia development. As shown in *Figure 2-10*, development of Surabaya coastal areas became national scale port is a dilemma dealing with conservation of coastal areas. Areas of coastal water ecosystems are dynamic ecosystems and have a wealth of diverse habitats, both on land and at sea as well as interact with each other. Besides having great potential, coastal ecosystems are also vulnerable to the impact of human activities. General construction activities are directly or indirectly, will adversely impact on coastal aquatic ecosystems. River Lamong project activities in the North Coast region Surabaya will create an international harbor and a waterfront city. However, this activity will threaten the existence of mangrove ecosystems that exist, although the region is only 10% of the sea, but holds nearly 90% of marine life.

Mangrove ecosystem damage also occurred in the East Coast of Surabaya. Triggered by events other than reclamation on river and coastal pollution levels, environmental declaration program protects the mangrove ecosystem in the region East Coast of Surabaya is very important to keep the environment sustainability. Conservation of East Coast of Surabaya will save the biodiversity and ecotourism potential of the region. A review of 2008 is known that the condition of 40% or about 400 acres mangrove forests in the region of East Coast of Surabaya is in damaged condition. There was a 29.8 km long coastline of mangrove in the region of East Coast of Surabaya, now only 8.7 km of mangrove vegetation is overgrown with a thickness of not more than 50 meters. This is very different from the situation in the 1990s, where the thickness of the mangrove forest can be more than 50 meters and they grew up along the shoreline in the East Coast of Surabaya.

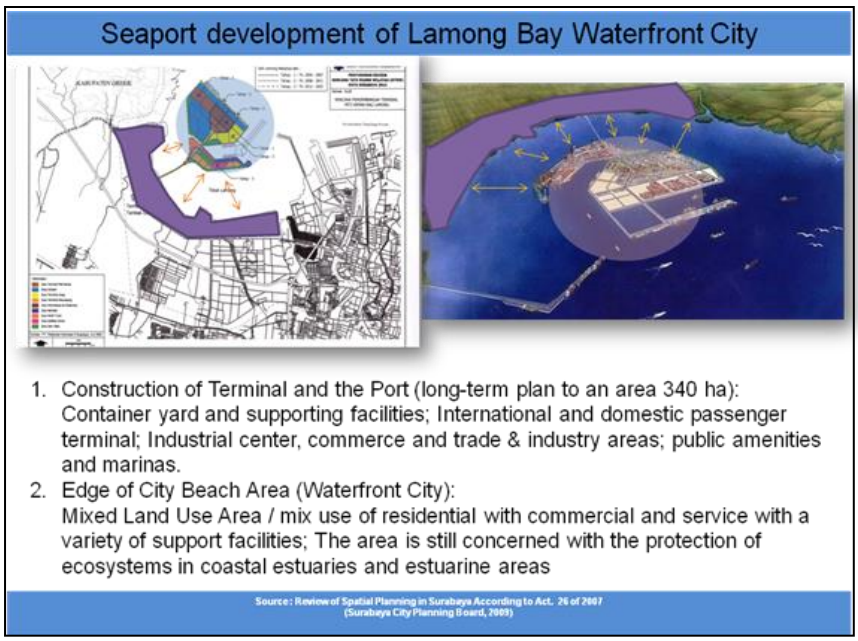


Figure 2-10 Seaport development of Lamong Bay Waterfront City.

(Source: Surabaya City Planning Board, 2010)

2.8.2 *Toward green city design: spatial structure and patterns*

In accordance with the laws of spatial No. 26 of 2007, the development of Surabaya city should refer to the long-term development plans of national, provincial and city of Surabaya for ensuring the proportion of green open space. In the design of long-term development plan of the town which contained 8 Surabaya's development missions. One of the Surabaya's urban development missions is making environmentally spatial planning and put its orientation to the principles of equitable and

sustainable way to achieve the eco-city Surabaya. Indication of the success of this mission is characterized by the preservation of green open space and increase the percentage of its range, decrease in the slums, the reduced extent of inundation/flooding, increasing the quality of the environment (land, water, air), the establishment of conservation of water catchments areas, the increase of natural resources can be utilized, and reduced marginal lands due to excessive water uptake, increasing the coverage status of basic infrastructure services settlement environment, the increasing coverage of water services, reduced levels of pollution in watersheds and coastal areas, the use of zones and areas of integrated coastal zone management and sustainable, less mangrove ecosystems and biological resources are damaged, increasing the contribution of the fisheries, the increasing role of the community, the increasing number of proposals for large-scale projects that use the concept of green city, green architecture, as well as the concept of sustainable development concept.

In the description of this mission there are 11 described the efforts in achieving this mission, namely:

1. Planning, utilization, control the intensity of land coverage, focused on efforts to control land uses that do not pay attention to the portion of green open space to build space.
2. Control of land conversion, control efforts directed at converting open spaces into green productive land up.
3. Slum reduction, aimed at reducing slum area, both in the city center, near the coast, along the border on the edge of the river and railroad tracks.
4. Reduction in disaster-prone areas, aimed at reducing disaster-prone areas, both flooded / inundation or fire.
5. Integrated Management and conservation of coastal areas.
6. Increased use of environmentally friendly energy is directed in an effort to diversify the sources of primary energy with renewable energy is more environmentally friendly.
7. Utilization of Natural Resources Renewable, aimed to increase the carrying capacity of nature and environmental preservation and welfare. Restrictions on the use of natural resources are directed to maintain stability and carrying capacity of nature to be done correctly.

8. Utilization of renewable natural resources is directed at meeting the interests of the carrying capacity of nature and environmental conservation and social welfare.
9. Water Resources Management, aimed to improve water resource management of surface water that provides justice for the community to meet the various needs of the conservation, utilization and control the water resources.
10. Housing and Settlement directed to fulfill the needs of the home as well as the formation of a healthy environment and appropriate allocation function. The project will also be directed to improve the distribution and dispersion of population and development.
11. Increase community participation in climate change mitigation and adaptation.

In Surabaya's development plan, the planning measures are suggested from the views of spatial structure and spatial pattern as the following:

1) Spatial structure: Establishment of service centers and sub centers in hierarchical service as national and international service centers, service centers and regional cities, Sub City Centre and the Centre for Development Unit (UP) and ocean zoning to be four zones to support the development of a knot trading activities and services based on the characteristics and potentials of marine areas as well as policy development is an integrated network system between the system of transportation networks, energy network system, telecommunication network systems, ecological network systems including green open space and water resources, urban infrastructure systems.
2) Spatial Pattern: the establishment of protected areas with the establishment of various protected functions of the city and the integrated conservation area covers the protection against the employee; local protected areas; nature reserves and cultural reserves; area of green open space; disaster-prone areas, and coastal areas marine areas as well as by improving the function of each area in the city of Surabaya, including residential areas; areas of trade and services; office area; the industrial area; the area of tourism; non green open space areas; the evacuation chamber; the allotment of space for informal sector activities and the other designation.

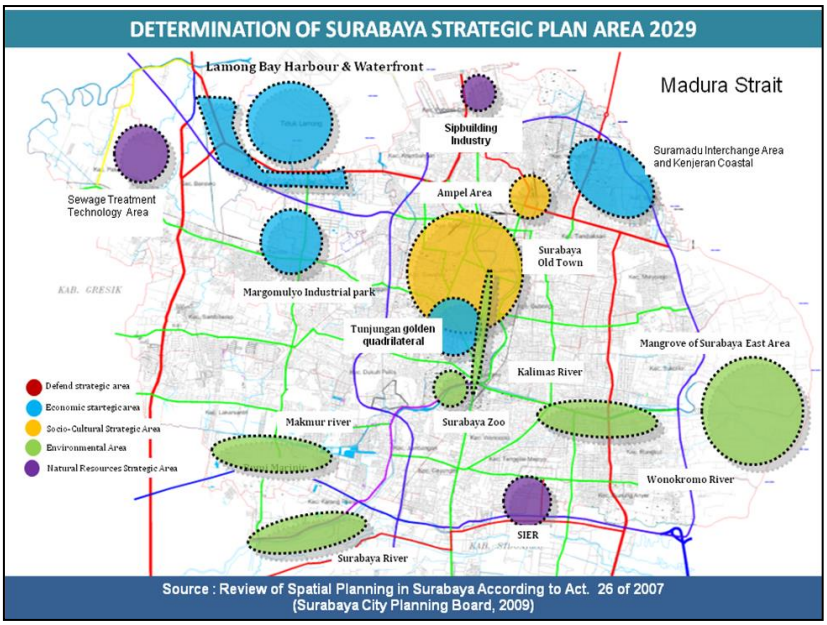


Figure 2-11 Determination of Surabaya Strategic Plan Area 2029.

(Source: Surabaya City Planning Board, 2010)

Spatial strategic planning based on economic aspects, the functions and carrying capacity of the environment, social, cultural, and high technology; and the development and/or limitation of function are shown as intended spatial structure and spatial pattern endorsed *in Figure 2-11* strategic areas in urban and regional scale.

2.8.3 *Discussion of Surabaya`s Planning Practice*

In Surabaya's development plan, an ecological approach to urban planning became a very important approach in anticipating global warming. Approach to effective functioning of open space (ecological, social and economic) into new approaches was taken into account in Surabaya's development plan. Effective use of urban space becomes a challenge in implementing the concept of green city design in this city. The city should be viewed as an ecosystem of dynamic interaction between social life community and nature environment, which becomes a major mindset in urban planning and design approach.

In the case of Surabaya's development plan, it can actually be done with physical intervention through urban planning and design in order to anticipate global warming in urban development. Urban planning and design that puts the interests of environmental sustainability is recognized as a guarantee of sustainable development not only for the current generation but also for future generations. Some policy interventions in urban space utilization are considered to ensure setting the urban

policy development and management from the following points in the case of Surabaya city:

1. Urban development should be continuing to be supported by the city's infrastructure (transportation, sanitation, drainage, etc.) that are environmentally friendly and adequately supporting the environmental sustainability efforts.
2. Efforts to use space should be done by reducing vulnerability environment, so that the environmental carrying capacity can be maintained to avoid the threat of rising sea levels, flooding, abrasion, and other natural hazards.
3. The design of urban areas should be able to sustain the ongoing ecological processes essential for life support systems and biodiversity, so that the ecological functions of the city remain stable.
4. The city government needs to apply the principles of good governance, so that the integration step between the public, investors and government can participate synergistically in creating a comfortable urban environment, and sustainable. Bottom-up approach emphasizes the role of the community (participatory planning process) in the implementation of urban development in a transparent and accountable to be more accommodating to the various inputs and aspirations of all stakeholders in the implementation of development, especially in conserving the natural environment.
5. Law enforcement is consistent and consistently – both government regulation, decree, or local regulations to avoid unilateral interests and for the implementation of role sharing a 'balanced' between the elements of stakeholders in creating a healthy environment and sustainable cities

As discussion above, a city is a very complex ecosystem consisting of natural, socio-cultural subsystems, and the economy. In addition to natural factors, socio-cultural aspects, and economics play an important role in planning and managing urban green open space, and wider urban environment. The success of urban planning and design is actually not located in a beautiful design outcome, but rather on how urban planning can be implemented. The city planners who have an important role to realize the product planning and urban design, with the involvement of all stakeholders, coordinate the city government. Increase the participation of all stakeholders, and better coordination of planning agencies are critical to the success of urban planning and design. Thus, it is still a long way to the goal of Surabaya’s development plan.

2.9 Conclusion in this chapter

This study is the result of reviewing the Long-Term Development Plan for 2005-2025 and Spatial Planning of Surabaya in the period of 2009-2029 from the view of green city design. In the Surabaya's development plan, the phenomenon of global warming, which will give a direct impact on coastal cities such as Surabaya, underlies the importance of making anticipatory efforts through urban planning. Some planning works anticipate a solution designed to provide input to the Government of Surabaya city including the revitalization of the river Kalimas, mangrove reforestation, solution development of green areas in the east of the city, and port development projects. But it all depends on the local government through anticipatory planning.

Substantially, products of city planning and design have become the major objectives in spatial strategic plan in Indonesia. However, for the implementation of green city design, as described above, Indonesia still requires a long process and the role of urban planning and design has a very large role in the effort to realize or toward green city. Besides, implementation of green city design in Indonesia is still facing very complex issues, including socio-cultural problems, economically and politically. This research report is expected to assist policy makers in the planning and design of the city of Surabaya, so as to anticipate global warming issue at this time.

Chapter 3 : The Spatial Arrangement Based on the Javanese Tradition to Determine The Flexibility of The House

3.1 Introduction

Urbanization is one aspect that is faced by cities in developing countries such as Indonesia. From the standpoint of a cultural phenomenon, urbanization is a cultural change from an agrarian culture to the modern culture of the city. According to Supriyadi, Sudarwanto, et al. (2012), generally most lifestyles are still based on agrarian culture, which is characterized by a simple way of life, togetherness, and strong social interaction. Current housing conditions in Indonesia are mostly limited to the physical condition and override the information of the residents (Anggraini (2012)). Housing is a representation of urbanization; this also occurs in housing at the fort of Yogyakarta Palace. In this housing, the influence of Javanese culture is very strong because the housing is within the grounds. It is interesting to learn how a Javanese community makes arrangements in their house in the middle of city developments such as Yogyakarta, outside of the palace grounds. Based on the fact that the design of houses within the research site is dominated by the activities and culture of the residents, this chapter studies an attempt to arrange the rooms of houses provided by the palace. According to Ahmad, Sultan, et al. (2002), the limited land and inter-family relationships will increase families. In the case of Javanese, It seems that people have made an effort to maintain the existence of the traditional positioning of rooms through a comparison with Basic Javanese Houses.

Focusing on aspects of the spatial arrangement of the house, this study finds that there are similar characteristics between the ideal Javanese house and the current Javanese house. The Javanese residents keep some spaces in the house for traditional matters; they tend to maintain their own traditions when developing their houses. The current situation is that many Javanese have built their houses with a variety of changes to the functioning of rooms in the house; there should be a lot of changes in

the spatial arrangement. In order to clarify the results through the arrangement of the rooms, research locations selected are in a strong Javanese environment, the controlled variable is a function of the spatial aspect as generated by daily activities.

Studies on the spatial arrangement and determining the similarity of spaces maintained in the house of a Residential area along the Fort of Yogyakarta Palace (RFYP) require research in accordance with the needs and activities that occur in the house. Residents developed plots they received from the king of Yogyakarta; the basic form of houses is that they are in lines, joined with other houses; although some of the houses are built in a row, they maintain separate structures. In the house, rooms are usually linked together in different ways depending on the structural integration; making some rooms more accessible than others. The order of integration serves to regulate the interaction between occupants in the house. Based on Boutabba and Farhi (2011), important to get into the process of producing building space required spatial and social organization. Sustainable design represents a systematized knowledge about the specific urban design context, closely related to the value scale of the respective community. Values of sustainability are in line with values of the vernacular according to Rapoport (1969) that vernacular architecture is architecture with characteristics of anonymity, having been self-built, sustainable sources, and pragmatic approaches toward encountering environmental hindrances, in defining vernacular shelter.

Several studies using space syntax graphs have conducted studies on the rooms of houses, among other things, discussing spatial arrangement in interpreting manifestations of architectural space and form (Anggraini (2012)), the spatial configuration of the houses, before and after alterations (Omar, Endut, et al, (2011)), identifying the spatial distribution of domestic forms (Boutabba and Farhi (2011)), demonstrating the variation in family structure and the behavioural directives (Dawson (2002)), finding appropriate purposes of each space for sustainably built environments (Jeong and Ban (2011)), and generating Japanese house boundaries (Kigawa (2003)). To enrich the research that has been done, this chapter also uses a space syntax approach to determine the flexibility of rooms based on the ratio of a particular house.

This chapter discusses the spatial arrangement of Javanese houses, which will be helpful to support other housing developments and explain the decisions on spatial arrangement in the house in urban areas. This chapter is compiled in three sections. The first section presents the facts on RFYP, which have significant implications for

housing development. In the second section, the spatial arrangement of houses in the research location is examined by depth calculation, compared with Basic Javanese Houses. This section also explains the ratio of existing houses in the location compared with Basic Javanese Houses. Further explanation is also given about residents' actions in arranging the rooms in their house; their decisions regarding arranging the room, and their determining of the flexibility of the rooms. The last section contains the conclusion that highlights which rooms are important for the people of Java, those that have a ratio similar to the Basic Javanese House.

3.2 Research Area

3.2.1 *Overview*

Yogyakarta is a city and the capital of the Yogyakarta Special Region in Java, Indonesia. The area of the city of Yogyakarta is 32.5 square kilometres. While the city spreads in all directions from the *kraton* (the Sultan's palace (King)), the core of the city is to the north, centering on Dutch colonial buildings area and the commercial area. In the southern area there is a castle area that is a local region where the nobles lived (*Fig. 3-1*). The existence of Yogyakarta Palace Fort (YPF) does not extend outside of *Kraton Ngayogyakarta Hadiningrat*, the core of Yogyakarta City. *Kraton Yogyakarta* as a centre of new power in Java and was developed by *Sri Sultan Hamengku Buwono I.* At the start of 1956 he began to build assorted support buildings and places for governance activities. What he did was not only to fulfil functional aspects, but the political, strategic, technical, religious and philosophic aspects as well.

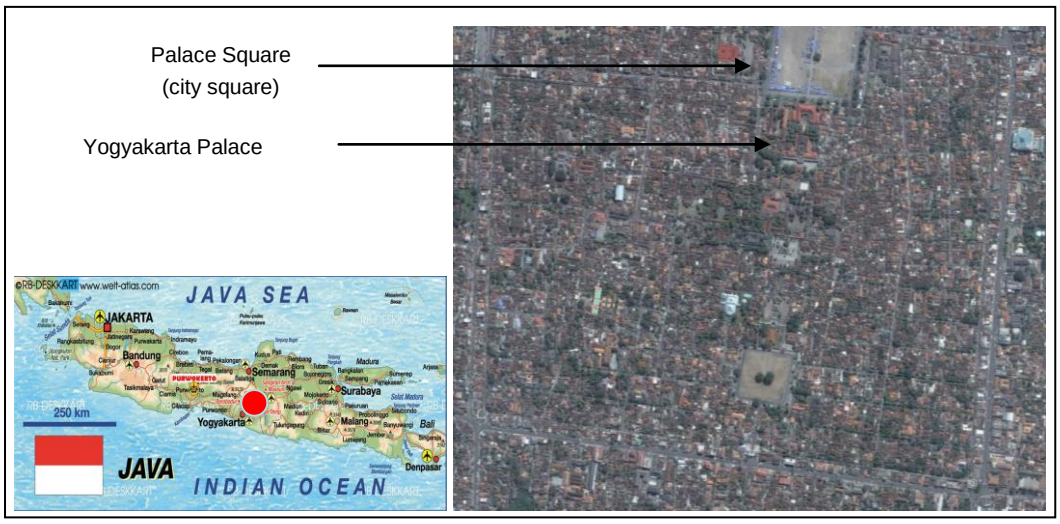


Figure 3-1. Map of Yogyakarta City and aerial view of Yogyakarta Palace.

From the strategic aspect, the development of kraton was considered to be strategic in security defence, politics, and for socio-culture purposes. *Cepuri Kedhaton* represents a ring (defence radius) of central defence, *Baluwarti Fort* follows the *jagang* (a moat), representing the ring of first defence, *Code River* and *Winongo River* represent the ring of second defence, *Gadjah Wong River* and *Bedhog River* represent the ring of third defence, and also the *Opak River* and *Progo River* represent the ring of fourth defence. This defence system is important regarding urban heritage preservation efforts, as it goes hand in hand with strengthening Yogyakarta City's identity (Annex regulation of Yogyakarta (2004)).

Structurally, YPF was first built with walls as thick as 3 metres wide and 3 metres high. The top of YPF was used as an observation platform by *prajurit* (soldiers) and was also a place from which military trumpet calls could be made. YPF's structure was built with the geometric form of a square, in principle, with a few elements of the building as *tetenger* (symbols) of certain places, for example in the *plengkung and regol* (form of a gate), and the apex of a fort corner. Nowadays some of the elements have fallen to pieces, most because of natural disaster and war, some others because of ruining by local people.

Yogyakarta, no doubt still encounters typical problems regarding historic urban preservation. Many elements of Yogyakarta's townscape have a serious problem, particularly with physical and visual degradation. One of those elements is the fort (*benteng*) of Yogyakarta Palace (*Kraton*), beside *Tamansari* and *Dalems* (the noble's residence). The fort actually assembled the city structure morphology by its position surrounding the palace, formed by a wall inside, 3 meters wide and 3 meters high. It is a symbol of the birth of new power in Yogyakarta in 1755. In 1969 the palace permitted the area to be built on by vendors and for social activities; gradually that area became a settlement, however nowadays, parts of the fort are beginning to ruin. Only native people were permitted to occupy that area, within the bounds of the palace regulation. The fort still showed a latent function for the sake of defence, but not in the same way as the old city had. Now, it acts like a buffer that keeps the palace away from outside influence, especially regarding land rights (*Fig. 3-2*)

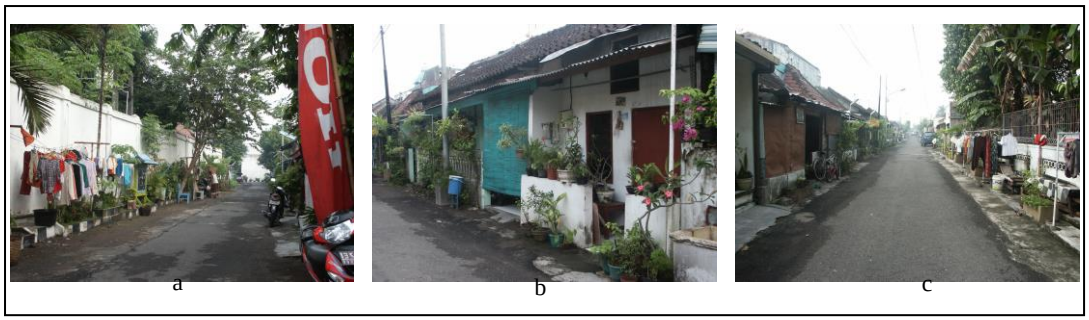


Figure 3-2 The housing condition in RFYP.

a) The houses opposite the fort. b) A line of houses that are not fenced, their yards in the form of roads. c) Environmental conditions and narrow roads for cars.

Nowadays the area of *jeron beteng* is occupied by 29,297 people (2007), a density about 21 people/km^2. This density is categorized as high level in Indonesia. A unique phenomenon of the settlement is that dwellers came from various areas with various cultural backgrounds and professions; even if they did not previously reside within the *Kraton* or adhere to Javanese cultural values (Poerwoningsih, Tutuko, et al. (2008)). That matter also caused a lack of upkeep of traditional conventions or palace regulations. Nevertheless, the cultural values of Java can still be seen to dominate in comparison with other dissimilar areas outside of *jeron beteng*. Generally, social status is from a middle economic level downwards. Related to the existence of the community of RFYP, with the status *magersari* (one of palace land rights), most dwellers said that they have known about the existence of orders and regulations during the course of both dwelling and building (*Table 3-1*).

Table 3-1 Dweller Perception Regarding Kraton's Regulations.

Dweller Perception About *Kraton*'s Regulation	**Percentages**
Knowing about existence of order and agreement from Kraton	71%
Knowing about Status *magersari*	87%
Knowing about width area of building	60%
Knowing about prohibition to develop building vertically	93%

Source: Data were collected from questionnaires

The charisma of the palace was a prior reason for dwellers to occupy in those areas, despite many constraints. One of these constraints is limited space in dimension about 3 x 4 m^2 for each family. Since 1969, the fort area has been occupied by at least 300 families. The housing located around the palace is limited by the fort (*Fig. 3-3*).

The housing development needs to maintain the rules of the palace as a representative of Javanese culture. We have studied a settlement that has *kampong* (urban

village) characteristics in an area of fort remains. The study subject that was selected has its own characteristic in the sense of its physical limitation that was caused by the palace regulations, and also because of its physical environmental condition. We aimed our study toward understanding interesting phenomena about how the dwellers of RFYP behave spatially. This paper was based on general issues of how the dwellers of RFYP attempt to make adaptations spatially or physically within a limited space or place; a behavioural approach indeed. Particularly, from the empirical, we found a unique stereotype that we considered as having competence to contribute to the attempts of heritage preservation and conservation.

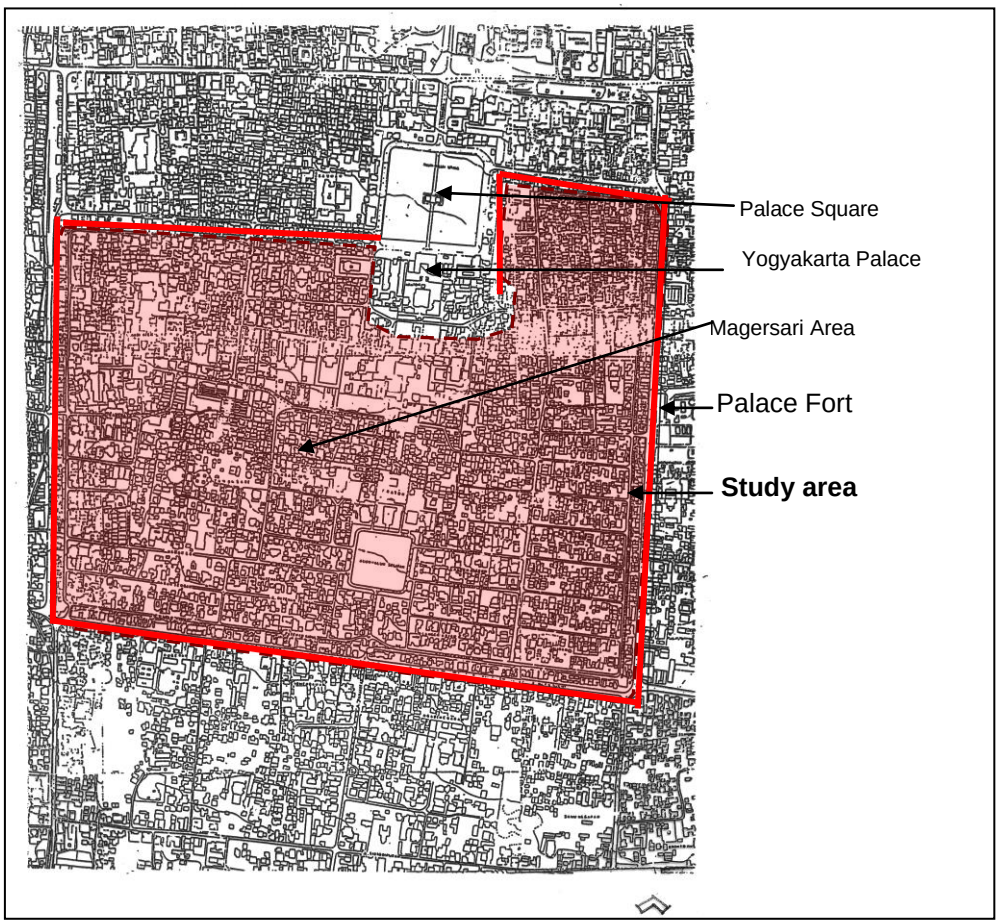


Figure 3-3 The Residential area along the Fort of Yogyakarta Palace (RFYP)

3.2.2 *Physical Condition*

The change of YPF of course began from the community's need to get a residence and to live in the palace environment. Furthermore, existence of YPF in the centre of the city and its accessibility was attractive to people to live in. Nowadays, empirical data shows that it was because of urban crowding pressures on the historic urban area. For the first time in this RFYP, the palace allowed people to build their public facili-

ties for example *Balai RW* (meeting room hall) and also mosques. Here in after, the palace allowed this location to be used for building houses for people who needed to live in this environment, but of course with several conditions. The physical setting of the environment is characterized by the linear form of houses alongside the remains of the fort. Some parts of the street environment are used to accommodate domestic activities, like *warung* (street vendors), even washing and drying clothes. That spatial behaviour also creates physical problems on the fort walls; there are even some houses that cross over the fort wall.

44% of buildings have coverage of more than 24m^2. Even 10% have building coverage of more than 48m^2 (400% of the allowed area coverage). Some respondents even own more than one plot of land. This is showing the possibility that there will be a process of sales that cause the transfer of property statutes. This matter shows the uncaring nature of palace regulations, especially regarding building coverage by dwellers (*Table 3-2*). In other cases, some dwellers have wiser spatial behaviour, creating optimal space under the top of their houses' roof as an alternative extension of space. Thereby they still do not oppose palace regulations, but still also have an optimal solution. Space above the ceiling represents space that is often too low, an inconvenient size especially in a tropical climate, which is perhaps very hot (*Fig. 3-4*).

Table 3-2 Percentage of Building Coverage Area

Building Coverage Area	Percentages
less than 12 m2	0%
between 12-24 m2	46%
between 24-48 m2	44%
more than 48 m2	10%

Source: Data were collected from questionnaires

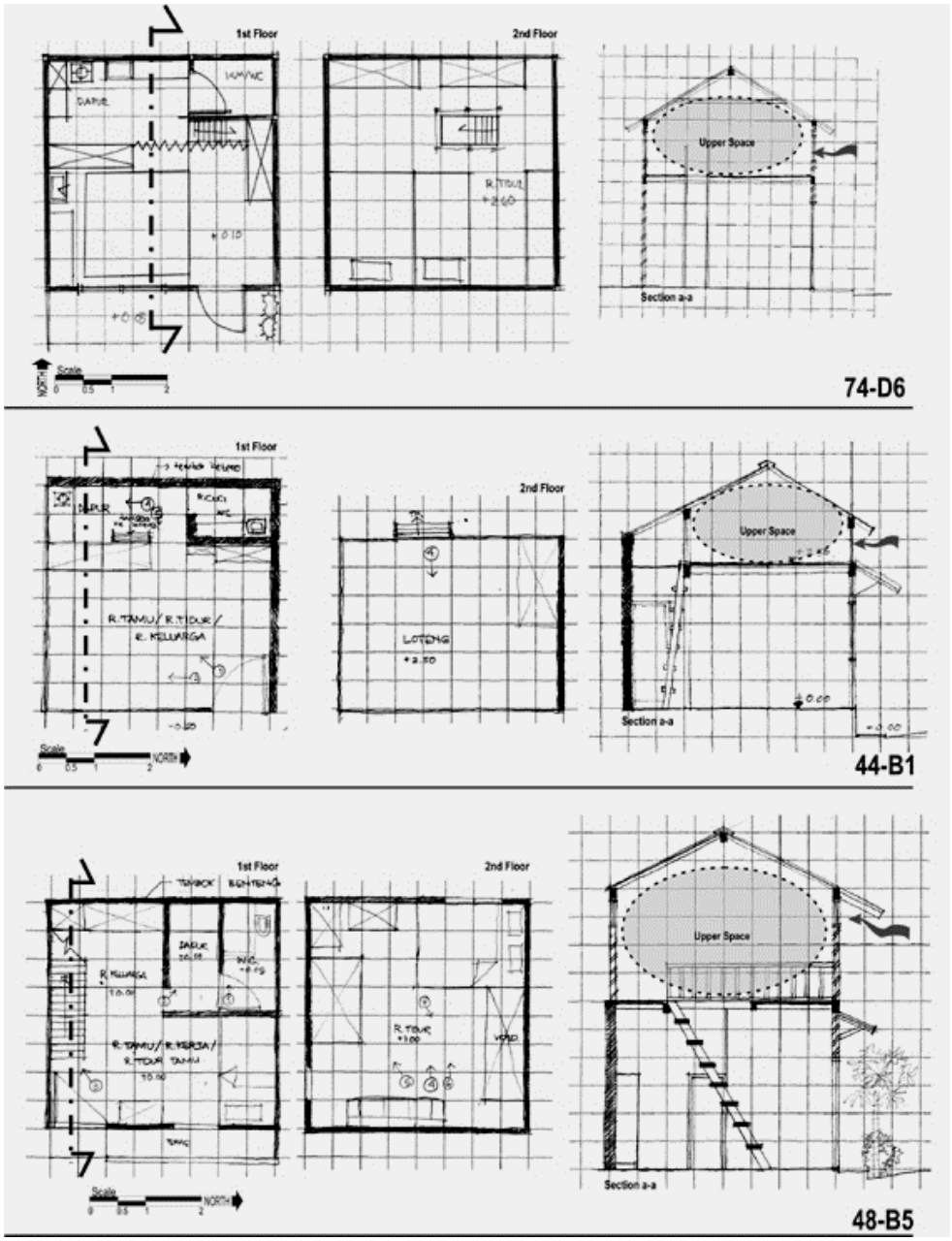


Figure 3-4 Plan and section of semi vertical building

The other dwellers' efforts not to build solely vertically, has resulted in placement of a second floor on the backside of some buildings so that they are not seen. By the variety of the dwellers' behaviour, there is indication that some members of society still confess palace regulation authorities do not oppose it. Adhering to the values of palace regulations (consistent with the regional customs system) is still embraced and structurally evident.

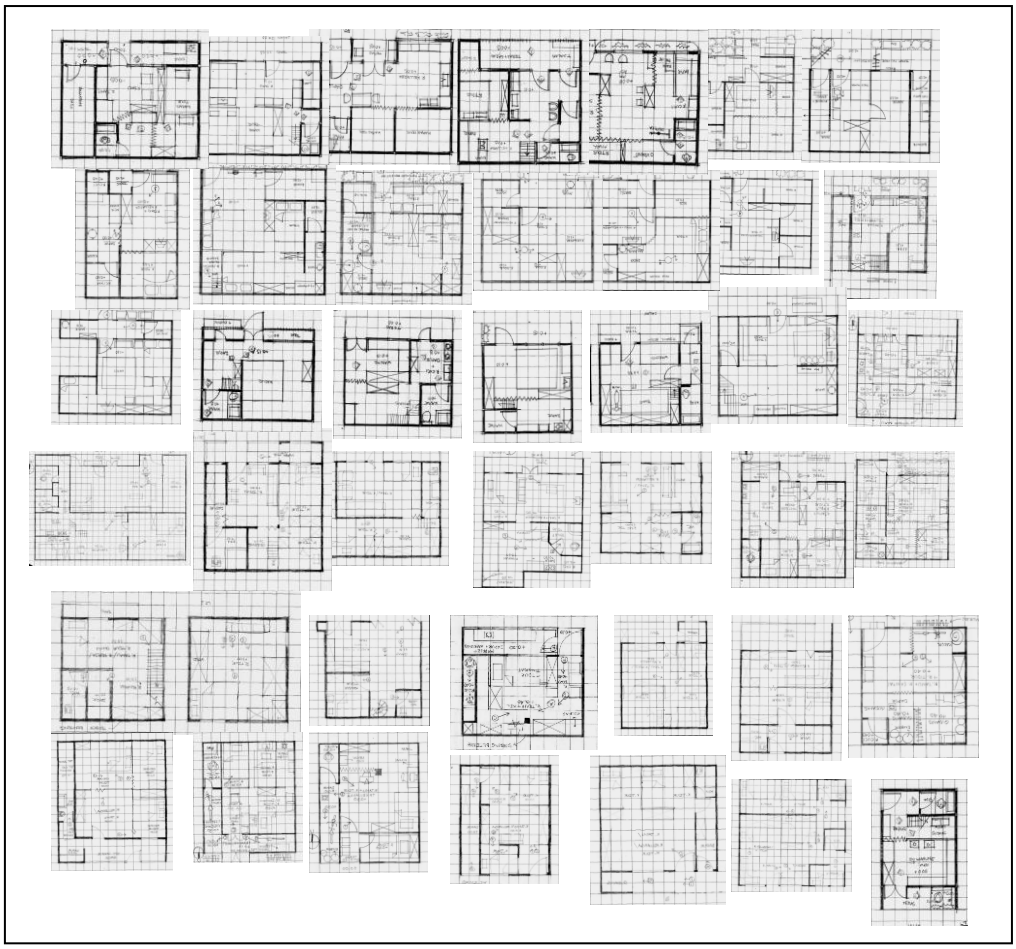


Figure 3-5. Sketch of houses along the palace of Yogyakarta

Based on observations in the field there is a wide range of houses conditions, it is necessary to do more detailed searches at houses. The houses that represent the changes were sketched (*Fig. 3-5*); besides, conducted interviews with the owners to obtain information about the condition of houses and their activities.

3.3 Methodology

"*Space syntax is a graph-based theory used by architects to examine how the spatial layout of buildings and cities influences the economic, social, and environmental outcomes of human movement and social interaction*" (Dawson (2002)). This method can be used to find the spatial arrangement, and conduct studies on activities and rooms with the purpose of understanding the spatial arrangement. For this study, it is first necessary to determine the depth of the Basic Javanese House and then calculate the depth of Javanese houses that exist at the sites.

Units of research include about 71 houses within a total population of about 300 families. The data was collected by observation, questionnaire, and interview. The

observation technique used in the study was Behavior Mapping. By this method, we can identify what people are doing and what they have done. Based on the interview, residents prefer to do activities in **the living room, family room, and kitchen.** They arrange those rooms based on their activities. The research approach uses space syntax analysis through Justified Graphing. Firstly, justified graphs are used to study depth (number of interconnecting spaces) and secondly, to analyze the house depth, specifically in the living room, family room, and kitchen. The living room and dining room are connected to all other rooms and one room serves as a corridor (Anggraini (2012)).

The houses were sketched and then depth was calculated using the justified graph. Through this observation we found patterns that represented what the respective dweller did. We believe the patterns that were found could be informative regarding the spatial arrangement linked to Basic Javanese Houses.

3.3.1 *Justified Graph*

According to Dalton and Dalton (2007) regarding network graphs, all space syntax analysis relationships can be conceptualized using a network graph. The types of graphics that are used in space syntax is specific and, in some ways unique. The graph in the space syntax analysis shows the concept of integration, which is analogous to the proximity measure as used in graph theory (*Fig. 3-6*). "*All lines are intersected by a line beginning at a depth of 1 is considered to be from the original line*" (Dalton and Dalton (2007)).

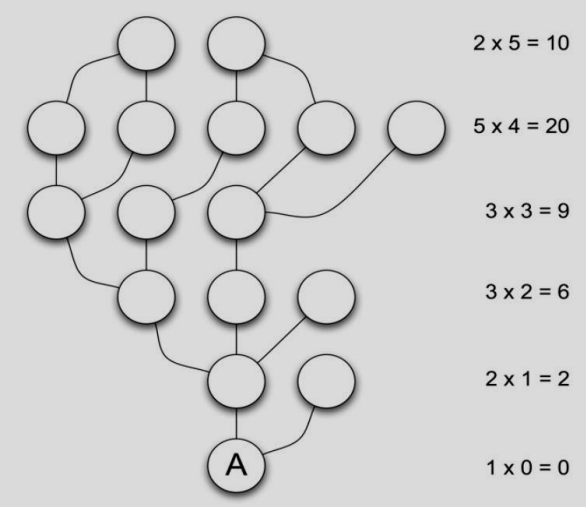


Figure 3-6. Justified Graph on Dalton and Dalton (2007)

Research was carried out by using graph theory to calculate the total depth at each house. The steps are as follows: 1) Calculate the total depth at Basic Javanese House; 2) Calculate the total depth at every house; 3) Conduct statistical analysis of existing data; 4) Group the data; 5) Analyze the house depth of the living room (lv), family room (fr), and kitchen (k).

3.3.2 *Research Plan of the Spatial Arrangement on Javanese House*

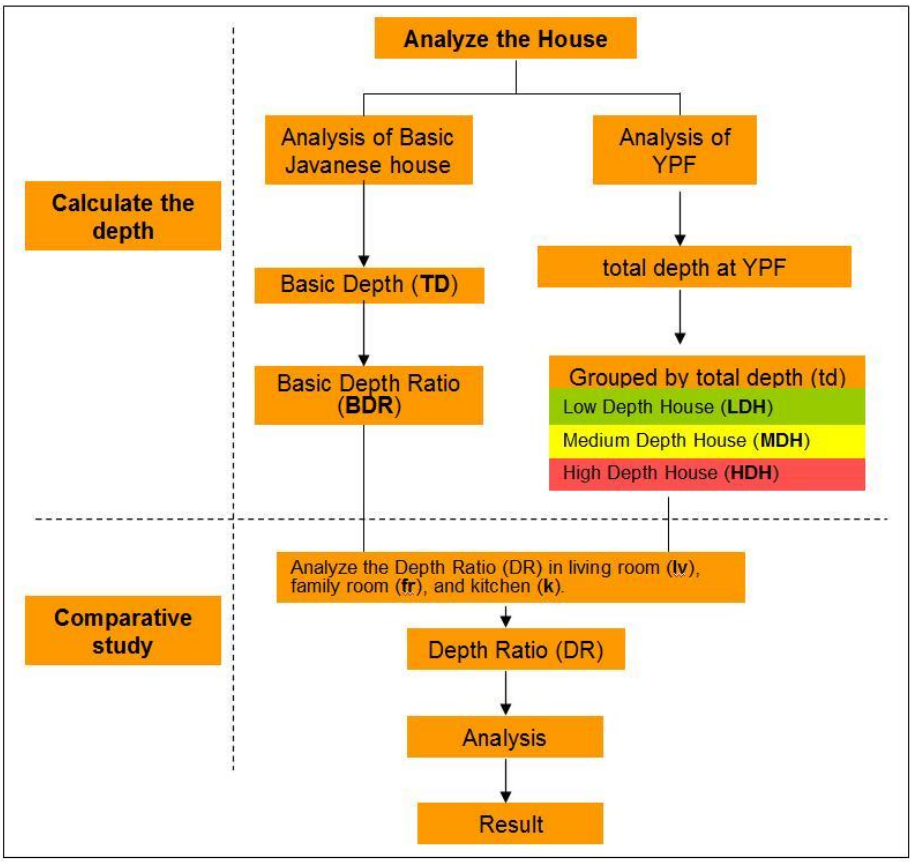


Figure 3-7. Research Plan of the Spatial Arrangement on Javanese House.

The analysis carried out in this study first assesses the Basic Javanese House and houses in YPF (*Fig. 3-7*). First of all an analysis to determine the depth of a Basic Javanese House is done, specifying basic depth (TD). Then, to get into the particular rooms (living room, family room, and kitchen), a depth comparison is performed with BD, so the Basic Depth Ratio (BDR) can be determined in these rooms. Total depth (td) was set for houses located in YPF; this process continued as for the Basic Javanese House, so that the resulting depth (d) in particular rooms could be determined. The next process is the depth analysis, this process is done by comparing the BDR and Average Depth ($\bar{d}$) in particular rooms. The comparative results were analyzed by using statistics that can be visualized in the form of tables and diagrams.

3.4 Spatial Arrangement present in the Basic Javanese House

According to Ronald (1990), he states houses are traditional works, works that are based on the standard of life for certain people, and its spatial arrangement brings unity and harmony among the spatial components. In view of the Javanese cultural context, the meaning of private-public spaces such as sacred-profane, usually together in the same room, is not obvious; physical boundaries are arguably blurred. According to Supriyadi, Sudarwanto, et al. (2012), a personal space expands to some extent into the public sphere as well. Space outside the houses usually does not have rigid physical boundaries (*Fig. 3-8*), this space can be used by anyone. Javanese traditional houses consist of a configuration of space where, from front to back, are the *pendapa* (living room), *longkangan* (alley), *pringgitan* (terrace) and *sentong* (small room). The *sentong* is located in the deepest part - there are three rooms called *sentong sengah* (center room), *sentong tengen* (right room), and *sentong Kiwa* (left room).

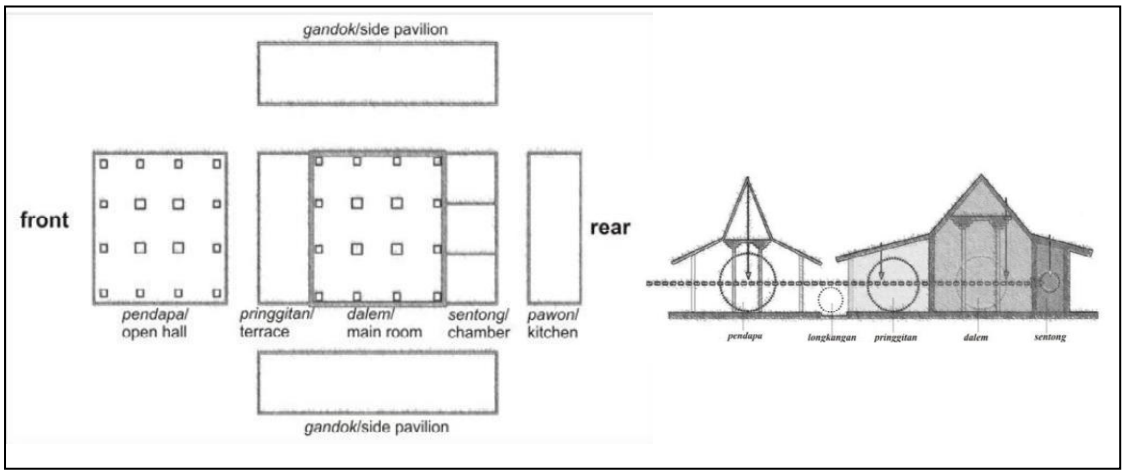


Figure 3-8. The arrangement of spaces in Javanese House and The schematic section of Javanese house (Supriyadi, Sudarwanto, et al. (2012)),

The Javanese community appreciates and tolerates changes and developments that come from both inside and outside Javanese culture. Even so, the characteristics of Javanese culture remain virtually unchanged. It is interesting to explore further their perceptions of their rooms in the house, and how they organize and determine the flexibility of each room.

3.4.1 *Analysis of Basic Javanese house*

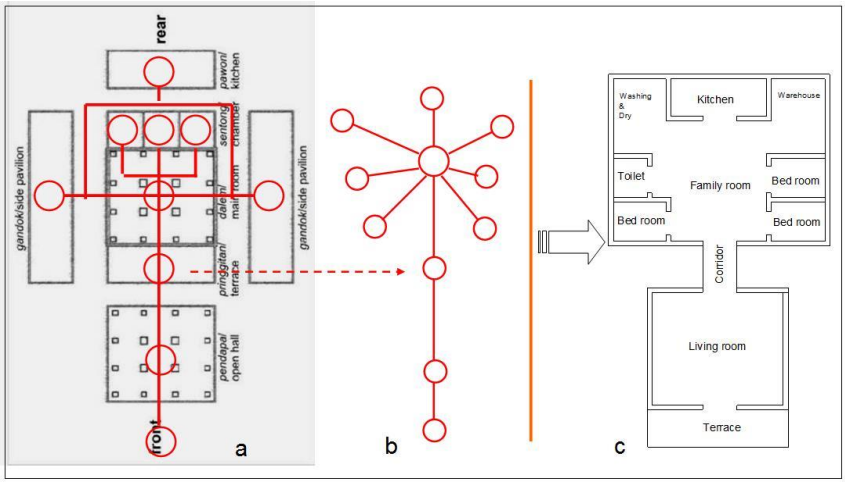


Figure 3-9. The pattern of the relationship between rooms on the Basic Javanese House

a) Linking between the rooms in house. b) Determining the hierarchy of rooms. c) Applying patterns to the existing Javanese house

At this stage, the study conducted analysis of Basic Javanese Houses with the aim to finding patterns of spatial hierarchy (*Fig. 3-9*) using linear methodology to show links between the rooms. The living room is separated in Basic Javanese Houses from other rooms; the corridor of a Basic Javanese House has no walls, as it extends, the corridor connects to the family room; the rooms contained in the Basic Javanese House are interconnected (*Fig. 3-9.a*). The next step is to determine the hierarchy of the each room to the outside of the house (*Fig. 3-9.b*); the goal is to determine the level of depth against the outer points. The hierarchy that has been found is applied to the Javanese house in order to facilitate visualization in real conditions (*Fig. 3-9.c*). Later, the position of the room is changed and the amount of space is determined according to the conditions that commonly occur in Javanese houses.

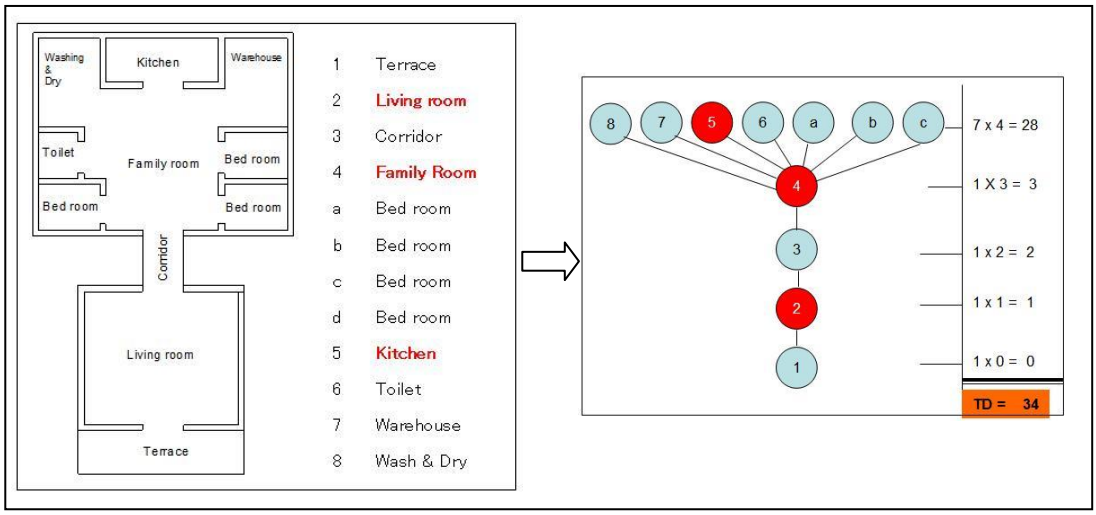


Figure 3-10. Justified Graph of Total Depth (TD) on Javanese House.

The next step is to perform depth calculations using the Justified Graphs of the Basic Javanese House (*Fig. 3-10*). A standard Javanese house is used as a reference to determine the basic total depth (TD). Results from the Justified Graph are used as a reference to determine the ratio of the houses located in the research area. Basic Depth of a Javanese house (TD) is the result of the sum of the depth of each room; the terrace (1) is considered the point of reference in the house, so its value is 0. The calculation result based on the Justified Graph is 34.

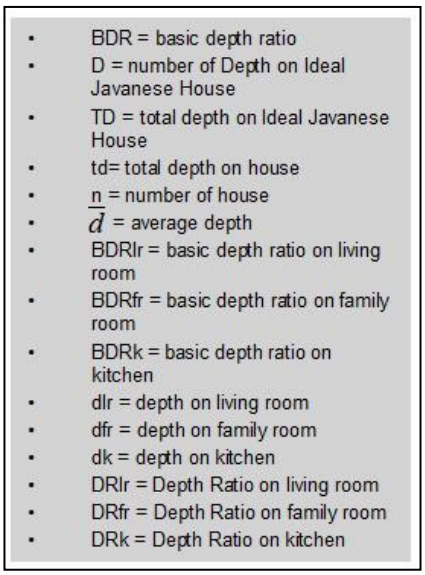


Figure 3-11. Notes of Depth Calculation.

To obtain the ratio of depth of particular rooms the Basic Depth Ratio (BDR) is determined; it is a ratio between the depth of a specific room (D) and the Total Depth (TD) of the Ideal Javanese House (see *Figure 3-11* for codes information). The BDR of the living room (lr), family room (fr), and kitchen (k) are:

Equation 3-1 BDRlr

$$BDRlr = \frac{Dlr}{TD} = 1/34 = 0.03 \quad \text{.....}$$

Equation 3-2 BDRfr

$$BDRfr = \frac{Dfr}{TD} = 3/34 = 0.09$$

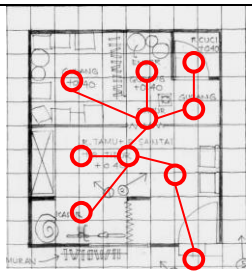
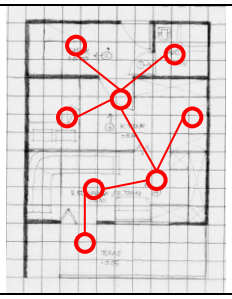
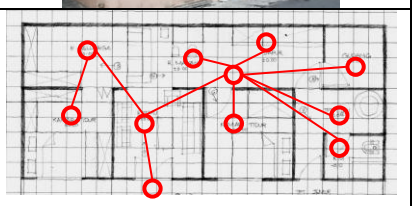
Equation 3-3 BDRk

$$BDRk = \frac{Dk}{TD} = 4/34 = 0.12$$

3.4.2 *Analysis of Existing Javanese Houses*

This survey was conducted on 71 houses around the YPF. The houses consist of three conditions based on size, i.e. small, medium, and large. The category of 'small-sized' contains houses of standard-sized plots, the category of 'medium-sized' contain houses of a standard size between 1-2 plots, and 'large-sized' plots contain houses larger than 2 standard size plots (one plot is about 3m x 4m). Each house was sketched and interviews were conducted with the occupants of the house regarding their daily activities in the house. Then interactions present between the rooms of the house were found (*Table 3-3*).

Table 3-3 Grouping house and examine the interaction between the rooms.

No.	Small	Medium	Large
			
			

Source: Collection of field data

Each house's total depth (td) was calculated, then statistical analysis was performed (*Fig. 3-12*). After calculating the depth, it appears the amount of depth is not based on the size of the house, but depends on the arrangement of the rooms found in the house. The houses are grouped into three groups based on their total depth, including Low Depth House (LHD) (25 houses), Medium Depth House (MDH) (37 houses), and High Depth House (HDH) (9 houses). The ratio of depth (d) was calculated for each group, comparing the living room, family room, and kitchen, with the total depth (td) for every group. The Depth Ratio (DR) is a comparison between the Basic Depth Ratio (BDR) and Average Depth ($\bar{d}$) in certain rooms.

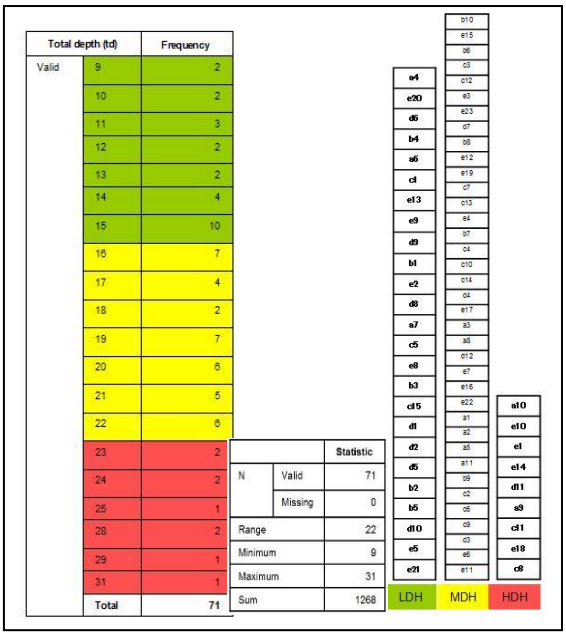


Figure 3-12. Statistical data houses examined in the field**.**

Average Depth in lr, fr and k are:

Equation 3-4 Average Depth

$$\overline{dlr} = \frac{\sum_{1}^{n} \frac{dlr}{td}}{n} \qquad \overline{dfr} = \frac{\sum_{1}^{n} \frac{dfr}{td}}{n} \qquad \overline{dk} = \frac{\sum_{1}^{n} \frac{dk}{td}}{n}$$

Depth Ratio in lr, fr and k are:

Equation 3-5 Depth Ratio for Living Room

$$DRlr = \overline{dlr} \Big/ BDRlr \longrightarrow DRlr = \frac{\sum_{1}^{n} \frac{dlr}{td}}{n} \Big/ BDRlr$$

Equation 3-6 Depth Ratio for Family Room

$$DRfr = \overline{dfr} \Big/ BDRfr \longrightarrow DRfr = \frac{\sum_{1}^{n} \frac{dfr}{td}}{n} \Big/ BDRfr$$

Equation 3-7 Depth Ratio for Kitchen

$$DRk = \overline{dk} \Big/ BDRk \longrightarrow DRk = \frac{\sum_{1}^{n} \frac{dk}{td}}{n} \Big/ BDRk$$

In order to inquiry depth easily, we tried to make a tool for inputting data from study area directly. We developed the depth calculation tool by the simple way and easy to use. Later, the data could be automatic exported into data base file for statistical analysis purpose (*Fig. 3-13*).

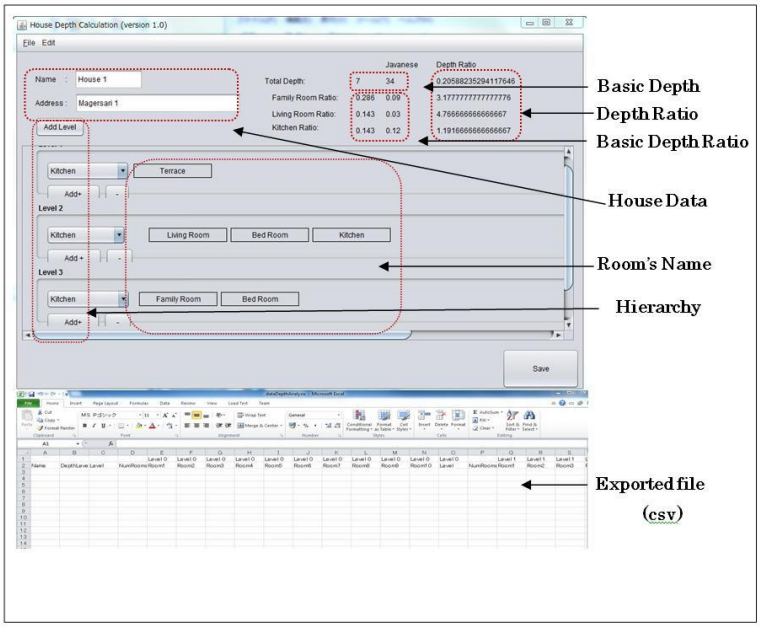


Figure 3-13. House Depth Calculation Tool**.**

This tool include Total depth information, depth ratio information, level of depth that represent of room`s hierarchy, name of house, and address. From this tool, we will try to develop not only for Javanese house, but other traditional house in Indonesia and later in other countries. Also it is possible to improve for urban scale purpose.

3.5 Results

Low Depth Houses (LDH)			
	dlr	dfr	dk
Total	2.18	2.79	3.81
Mean	0.34	0.81	0.79
DR	2.90	1.24	1.27
Medium Depth Houses (MDH)			
	dlr	dfr	dk
Total	2.11	3.39	5.50
Mean	0.06	0.09	0.15
DR	1.90	1.02	1.24
High Depth Houses (HDH)			
	dlr	dfr	dk
Total	0.47	0.80	1.15
Mean	0.05	0.09	0.13
DR	1.74	0.99	1.07

	lr	fr	k
LDH	2.90	1.24	1.27
MDH	1.90	1.02	1.24
HDH	1.74	0.99	1.07

Figure 3-14. Result on LDH, MDH, and HDH about ratio flexibility.

After the data is applied to the formula, the ratio results obtained for the living room, family room, and kitchen in each group provide information regarding the flexibility of each of these spaces (*Fig. 3-14*). The lower ratio is expressed when the DR of the room is proportionate to the BDR of the same room in the Basic Javanese House. The higher value of the room it will be more flexible. The highest value was found in the living room of an LDH (2.90), and the highest values for MDH and HDH, also in the living rooms, was 1.90 and 1.74 respectively. The family rooms of the LDH, MDH, and HDH all had the lowest values in the group, 1.24, 1.02, and 0.99 respectively.

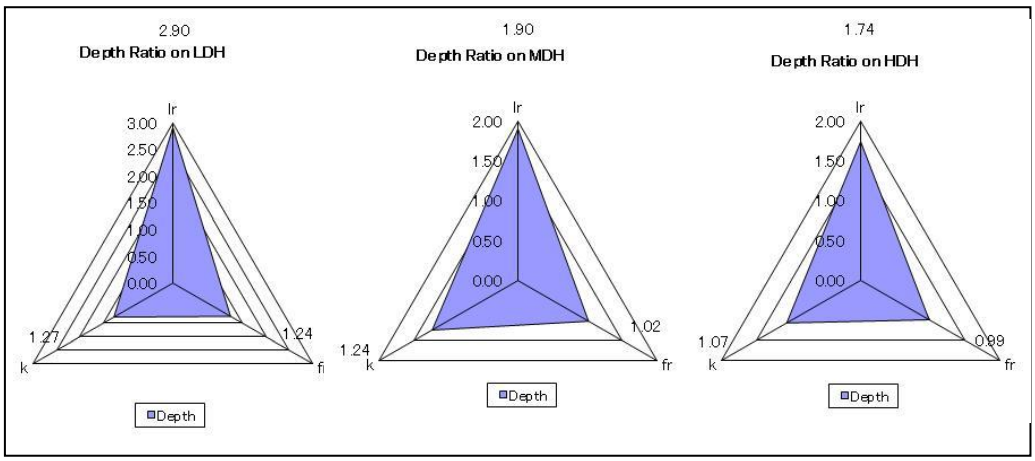


Figure 3-15. Radar chart on LDH, MDH, and HDH about ratio flexibility.

In the radar chart (*Fig. 3-15*), we can see that the living room has a high flexibility in the spatial arrangement of each group and the family room has a minimum flexibility in the spatial arrangement.

3.6 Discussion

The Javanese house is more open, utilizes a high level of connectivity, and tends to be grouped (Anggraini (2011)). The Javanese house has an outward orientation, indicated by a higher flexibility in the living room, although there are some fundamental changes to the spatial system in order to adjust the distribution of plots established by the palace. Rooms with higher connectivity, such as the living room, have a high significance of interaction in a Javanese house. The living room has high flexibility, because it has a high level of social interaction. It has an outward orientation but also a higher functional space in the house. The family room is the space for family socialization, but can still be used as a place to receive guests within particular conditions. This is what causes the family room to have a low level of flexibility,

because it abides by Javanese rules - that the living room is a specific room used for family purposes only.

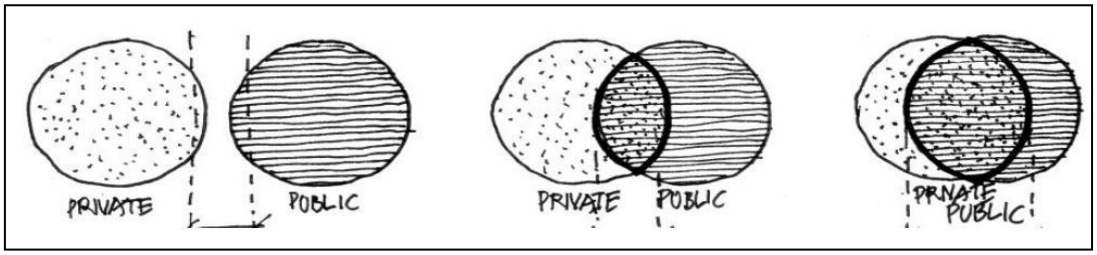


Figure 3-16. The relationship illustration on Public-Private space.

The schema showing the public-private space in the modern world (left figure) that is totally separated, and alternatives which merge these public and private spaces in traditional society (right figure) (Supriyadi, Sudarwanto, et al. (2012))

Social relations are very high in the Javanese community; social life as revealed by intensive interaction is very important. The greater the overlap of public space and private space, the higher the importance of social life (Supriyadi, Sudarwanto, et al. (2012)) (*Fig.3-16*). It is very different when the two are completely separate spaces as in a modern city environment, illustrated by the separation of the individual from social interaction. The public interest takes precedence over personal interests where social interaction becomes more important in the quality of life for the Javanese community.

3.7 Conclusion in this chapter

With the increasing development of the city, the palace faces a situation where they need to meet the needs of the residents. An understanding of the relationship between space requirements and cultural phenomena is needed. By understanding the spatial arrangement of a house and population growth, solutions to Java's significant housing problem can be found and within this, a direct understanding of the various parts of houses are considered essential.

Understanding the spatial arrangement of Javanese houses will be helpful to support housing construction and the arrangement of rooms for Javanese families. The facts on RFYP show that despite the limitations of land, most of the inhabitants still have respect for the rules and these are embodied in the arrangement of rooms in the house. The depth of rooms determines the importance of the position of the room; by knowing the ratio of the depth of a room, the ways in which residents follow Javanese culture can be seen.

Based on this ratio, it can also be seen that the living room has a high level of flexibility. This means occupants can more freely arrange the room as a living room. Meanwhile, the family room has a low level of flexibility, as it is considered very important for the Javanese family. This is in accordance with the Basic Javanese House, which puts the family room as the most important room, and also positions it in the middle of the house.

Chapter 4 : Vernacular Pattern of House Development on Home-based Enterprises

4.1 Introduction

Regarding the research related to the pattern of house development, the authors focus on changes of the spatial pattern in houses based on function from the view of Home-based Enterprises (HBEs). As a dwelling space, the houses serving as business spaces have been passed through generations; this study is expected to analyze the pattern of house development based on the needs of HBEs for their business activities. In the local community, imitation of the patterns is found in other residential places, in both physical and non-physical aspects, it is not only a shelter or home, but it can also serve as a mobilized resource for the occupants. Housing patterns are evident, not only based on home activities, but through identifying as vernacular it can be seen that the pattern is actually desired, by the occupant, to be passed to the next generation because the vernacular pattern is imitated by development in a particular area. The study of housing patterns based on income level is expected to assign a pattern appropriate for the needs of residences to be developed further, especially for HBEs.

According to Nunta and Sahachaisaeree (2012) the spatial pattern of human settlement was determined and readjusted not only by daily human needs, but also by their social norms and cultural settings. In addition, the local pattern and orientation of structural design was developed and transformed in accordance with the modern society (Saleh (2000); Saleh (2001)). The pattern of vernacular settlement explaining the significance of social identity and livelihood in the past could be beneficial to explain the current social dynamics in the modern urban community. Vernacular patterns also show that the house has existed for at least several decades (Aziz and Shawket (2011))

A settlement is a residential place of activities that support human life. According to Newmark and Thompson (1977) the terminology of house as a residence are shelter (as a physical shelter), house (as a place for people to perform daily activities), and home (as a residence or dwelling for a person or family who has a psycho-social environment).

Thus, the notion of house means as a place of residence (physical) for persons or families to perform activities of daily living and as a venue for self-development processes (non-physical). According to Silas (1993), the function of the house is not just for shelter, rest, and family (residential), but it also can serve as a mobilized resource for the occupants. Here is an explanation for houses with the combined functions of home and work: Home, a house used as a residence without other meaningful activities; and work, a house used for a productive or economic activity, which carries consequential aspects between production and home care.

Furthermore, there are several aspects to discuss about housing improvements such as: (1) Low building quality and slow construction evolution in the process of self-built houses (Kowaltowski (1998); Bredenoord and Lindert (2010); Abbot (2002a); Abbot (2002b); Ferguson and Smets (2010); Shiferaw (1998); Al-Naim and Mahmud (2007); Kigochie (2001); Sullivan and Ward (2012); Tipple (2004)), (2) The ability and motivation of households to consolidate their housing situation for self-help settlements (Kellett and Granham (1995); Ghafur (2002); Gough and Kellett (2001); Mukhija (2001)), (3) The symbiotic connection between house and economy, such as HBEs (Onyebueke (2001); Sinai (1998); Coen, Ross, et al. (2008)). Laquian (1993) says that for the people who live in slum areas, the house is not just for home-life, but it is a place of production, marketing, entertainment, and financial institutions. Residential and business activities are integrated within single unit houses. Whereas, the International Research on HBEs in 2002 states that, in general, an HBE is a domestic business activity. It is basically people's economic activities run by the family in which the activities are flexible and less bound by rules. According to Ferguson and Smets (2010), resources dedicated to incremental housing have to compete with other needs of the household.

House development cannot be separated from the existing resource (Silas (1993)). The aspects of productivity and the function of the home have become increasingly prominent in a variety of shapes and composition. Furthermore, Sarwono (1992) states that humans will always adjust the environment by considering the feasibility elements for human habitation, which are related to human needs.

On the other hand, Samadhi (2004) said, humans make their decisions through some cosmological process. According to aspects of the norm, it is also a consideration in determining the direction of house development. Turner (1972) explains the

concept of Housing as a process which is based on three things, namely the value of a home, home economic functions and authorities of a home.

There is a lot of research associated with the pattern of building a house. Bredenoord and Lindert (2010) generally explain the main factor in the procurement of shelter in developing countries is practicing incremental self-help housing. They mentioned that, in addition to the use value that the self-built house has for residents, the commercial value of the property is not less important and will also tend to increase. A house can be the family's moneybox, especially if the family has a high degree of tenure security and if the house is built in a durable way. Abbot (2002a) argues that house development is based upon the ability of external interventions and argues for the long-term sustainability of housing. In addition, Ferguson and Smets (2010) argued about housing finance, expansion prospects and currently status, as well as housing finance that encompasses individual and group savings, and also households who combine a wide variety of sources in order to build their homes.

The function of the house can be as either, or both, home and work. Some houses are used for productive activities and consequences arise in relationships between aspects of economic and house functions. This work focused on residential and business activities integrated within single unit houses. The functionality aspects of the house became clear in a variety of shapes and patterns as a form of existence and sustainability. Moreover, the house is intended as vernacular architecture, which is the work of the whole society and not as the choice of an individual.

According to Agenda 21 for Indonesia (1997), housing and settlement development goals are to support economic activity in a coherent system that ensures the preservation of the carrying capacity of the environment and natural resources, so that all layers and segments of society that grew and evolved by these activities are embodied in settlements which support sustainable qualities.

This chapter discusses the vernacular patterns in housing that has HBE activities, and is also expected to help support the development of housing in dense areas. This chapter is organized as follows; firstly, it investigates literature regarding the influence of urbanization on housing, the pattern of residential building, and motivation of residents to develop their houses, particularly in the area of the city. Secondly, it describes the research approach and reviews the patterns of house development from questionnaires and mapping of the houses within the study area. Analyses are needed to explain the physical and non-physical conditions in order to understand the

pattern. Thirdly, we discuss the vernacular housing pattern based on analysis and schematic diagrams. Finally, the conclusion states the importance of this study to enrich knowledge about house development in dense urban areas.

4.2 Research Approach

Vernacular buildings have similar sense for people to be in daily relationship with both the built environment and the surrounding environment; housing pattern maintains this tradition. According to Aziz and Shawket (2011), the principles of house development are sustainable, as seen in patterns of vernacular development. According to Ikuga and Murray (2012), vernacular is to deal with sustainability perspective. Structure Vernacular help people to take shelter using natural resources and provide economic needs, also in line with the values, lifestyles and cultural symbolic function. This will establish a reference point that reflects the culture of the entire social structure. HBEs allow houses to be expanded to meet the needs of business in line with the needs of the household. This development is done by mimicking what has been done in the surrounding neighborhood. Because this housing is homogeneous, the considerations for the new construction of the house are similar. To capture the aspects that result in this similarity, questionnaires to residents were used as an investigative tool for data collection. This investigation took aspects of the tradition, business processes, and living activities into consideration. Here is the conceptual framework for conducting the data collection in order to acquire the appropriate data for analysis (*Fig. 4-1*)

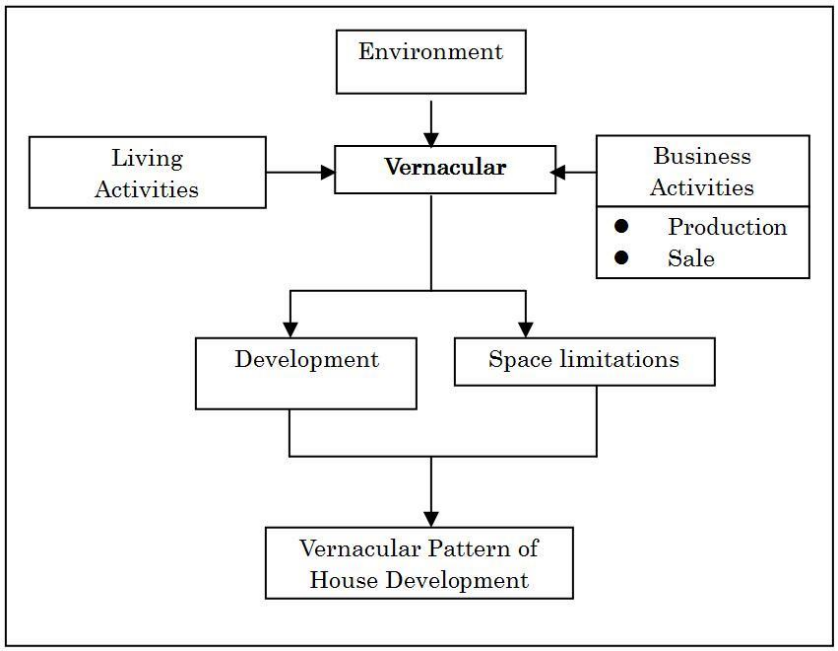


Figure 4-1. An Approach to the Pattern of House Development on HBE.

Data were obtained from questionnaires conducted on housing development to gain insight into the housing pattern of residents who have business activities. The questionnaire enquired about living activities and business activities consisting of both productive and commercial aspects. The questionnaire aimed to acquire the data regarding basic similarities in vernacular patterns that occur in the area. In accordance with the development of family activities and business activities, there is a need for house development; this has resulted in the problem of space limitation. Analysis was conducted of the obtained housing patterns based on the level of need for the development of the living or business.

4.3 HBE Housing Patterns in Kampong Sanan

The study area, Kampong Sanan, is located in the eastern part of the island of Java, Indonesia. The type of settlement is a kampong (urban village), which has a higher population density than the surrounding area. In Malang City, Indonesia, the place is popular for its “tempe”, that is famously known for being produced in Kampong Sanan. This location is a dense residential region and most people have similar daily day activities. This kampong has an area of 20Ha (*Fig. 4-2*) and the area is divided into four neighborhoods with a population of about 3300 people (660 households) in 2011. Based on the existing designation, the area is zoned for residential area. The

North and East sides of Kampong Sanan are bounded by the river and there are many new housing developments in the area. While the position of the kampong is surrounded by rivers, it is limited on the West side by the highway leading to Surabaya City (The capital city of East Java Province).

4.3.1 *House Development in Case Study Area*

The houses of residents who live in Kampong Sanan have two functions: home and work. The productive activity of work has resulted in a unique pattern of settlement. The preserved areas (Kampong Sanan Tempe) maintain the image of the area as a tempe-producing area where there is a tendency for integrating their living space with the business space and their patterns are influenced by their economic level. Sanan residents cannot be separated by their activities of producing and selling tempe, this particular activity differentiates this kampong from others. The residents try to maintain their activities and this has ensured the phenomenon remains today.

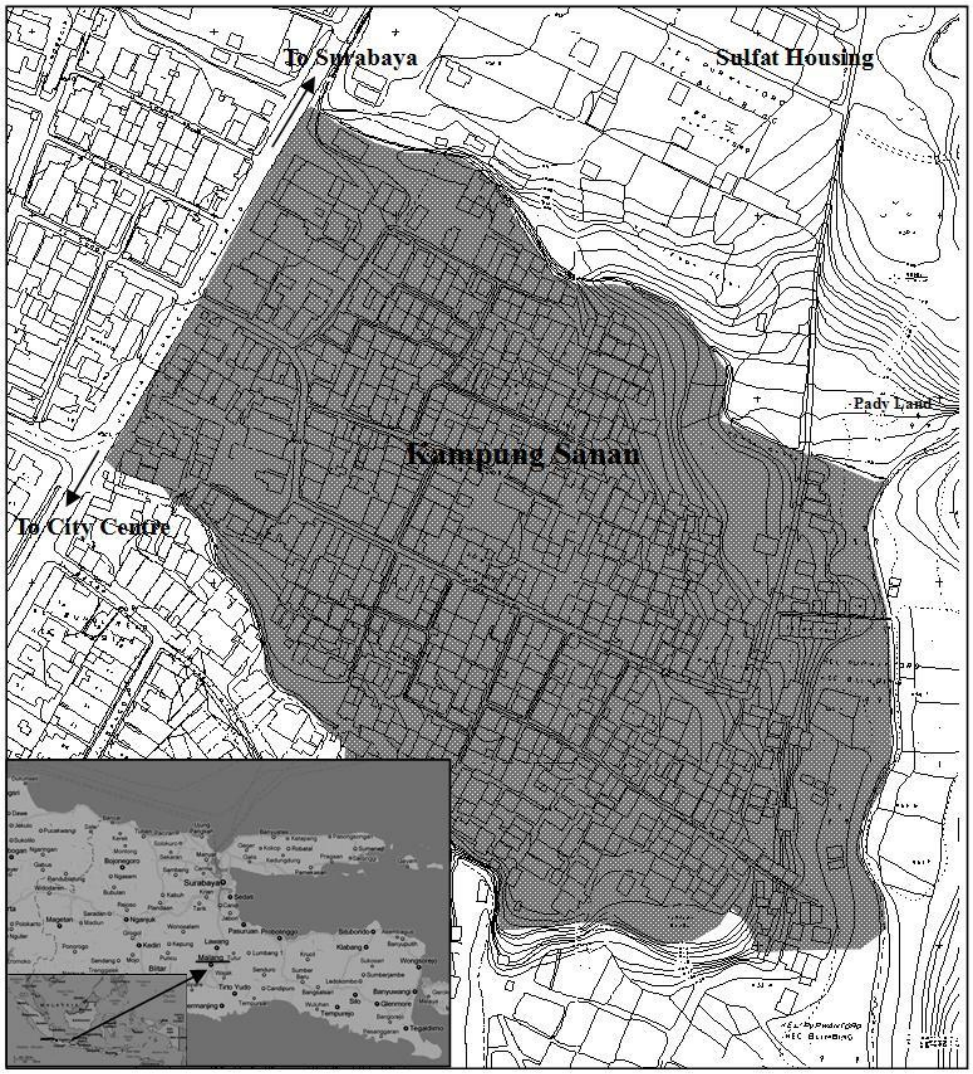


Figure 4-2. Kampong Sanan Boundaries**.**

Residents are differentiated into three groups based on their economic level, the high level, middle level and lower level. The high level residents are on the edge of the main road and they have a good opportunity to improve the home. The middle level residents have a chance to grow because they have direct access to the main road of the kampong. The low economic level residents are on the inside; their houses are difficult to develop because of the limitations of the land and housing density (*Table 4-1*). Groups of houses in this area are illustrated in *Figure 4-3*.

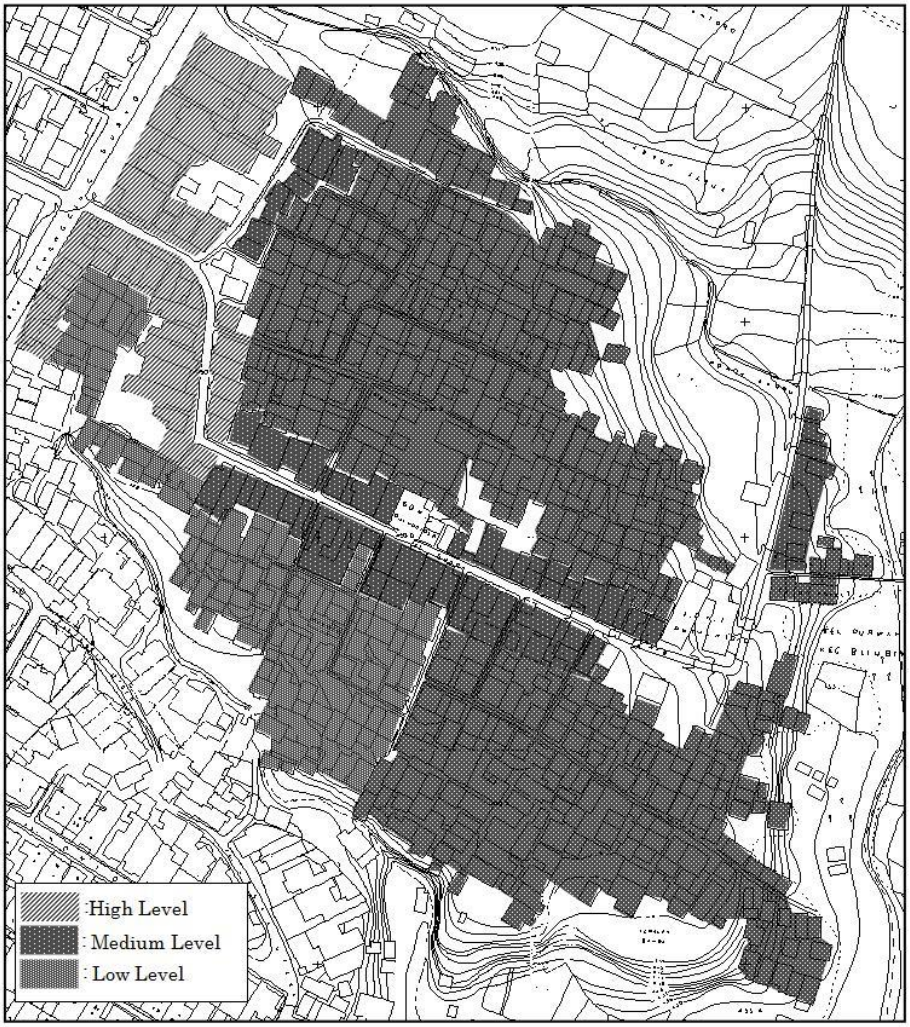


Figure 4-3. Three Groups of Resident in Kampong Sanan.

Table 4-1. The Economic Level and housing Condition.

No	Groups	Conditions		Figure
1.	High Level	Location	Located near the city's main road in front of Kampong Sanan, the appearance of the stores change completely.	
		> .1	They are focused on selling products,	

			and have developed their entire ground floors for business activities.	
2.	Medium Level	Location	Almost all ground floors are used for economic purposes and, but the appearance of the house is still present. These houses are located near Kampong Sanan's main road.	
		Activities	The front of the house is used for economic purposes, but the appearance of the house is still present, these houses are mostly located inside the kampong.	
3.	Low Level	Location	At the rear of houses, both household and business activities (production) take place.	
		Activities	At the front of the house, there is also space used for business activities (production). There are some space limitations and conflicts between both activities.	

Source: Field survey and the pictures were taken in 2011

Residents will consider the construction of their houses relative to their economic level grouping. Their considerations are based on home ownership status, financial resources, and income per month.

Table 4-2. Relationships between ownership status, income per-month, and other finance.

Ownership Status		**Finance**	**Average Family income per month**					
			Low		**Middle-**		**High**	**Total**
			<500.000	**500.000-750.000**	**750.000-1.000.000**	**1.000.000-1.500.000**	**>1.500.000**	
Own House	Cost Source	Savings	31.7%	39.7%	14.3%	3.2%	4.8%	93.7%
		Borrow	6.3%	-	-	-		6.3%
Lease House	Cost Source	Savings	28.6%	57.1%			14.3%	100%
Family Legacy House	Cost Source	Savings		45.0%	35.0%	20.0%		100%
	Total							

Based on the status of ownership, the largest financial resource for construction is from savings among families with a monthly income between Rp. 500,000 to

Rp. 750,000 (39.7%). The main financial source for Lease House residents and Family Legacy House residents is also from savings (57.1%, 45% respectively), so people prefer to use savings rather than loans to others to improve their houses. From *Table 4-2*, we can conclude that the ownership status of residents living in the kampong is the most important condition to overcome obstacles in savings. The financial resource is an assurance in the process of house development.

Table 4-3. Relationship between Ownership status, Development Status, Income and Finance resources.

Ownership Status	Development Condition	Family income per month	Finance Resources
Own House	Steadily	Most of the families with incomes Rp. 500.000,- to Rp. 750.000,-	Savings (59 respondents) and loans from others (4 respondents).
Lease House	Grows	Family with incomes Rp. 500.000,- to Rp. 750.000,-	Savings (7 respondents).
Family Legacy House	Grows - Steadily	Family with incomes Rp. 500.000,- to Rp. 750.000,-	Savings (20 respondents).

Based on field data in *Table 4-3*, the cost for the process of repair and construction of homes is funded by both residents' savings and a fraction of borrowing from other parties. In addition, comparing the ownership status and the duration of business in the kampong with the reason for doing business can be organized as below, in *Table 4-4*.

Table 4-4. Relationships between ownership status, duration of business in the kampong, and the reason for keeping the business**.**

Ownership Status	Business activity	Years	The reasons		
			Maintaining tradition	Being familiar with the product	Supporting Environment
Own House	The duration of doing business in the kampong	<1	7.9%		
		1-5	7.9%		
		6-10	11.1%	4.8%	
		11-15	4.8%		
		>15	39.7%	19.0%	4.8%
	Total		71.4%	23.8%	4.8%
Lease House	The duration of doing business in the kampong	<1	28.6%		
		1-5	28.6%		28.6%
		>15		14.3%	
	Total		57.1%	14.3%	28.6%
Family Legacy House	The duration of doing business in the kampong	1-5	35.0%	10.0%	
		6-10	10.0%		
		>15	20.0%	15.0%	10.0%
	Total		65.0%	25.0%	10.0%

Based on *Table 4-4*, the residents with Own House status residing for more than 15 years prefer to "maintain tradition" to support their business activity in the

house (39.7%). The Lease House status residents preferred “Being familiar with the product” and “Supporting Environment” as their reasons (28.6%) for those who have resided from 1-5 years. The Family Legacy status residents who have resided from 1-5 years preferred “maintain tradition” (35%) as a reason that supports their business.

Table 4-5. Summary the influence of house status, main factor, and duration of doing business to development status.

Development Status	Ownership Status	The Main Factor	The duration of doing business
Steadily	Own house	Maintaining tradition (45 respondents)	More than 15 years (25 respondents).
Grows	Lease House	Maintaining tradition (4 respondents)	Between 1-5 years (4 respondents)
Grows-Steadily	Family legacy	Maintaining tradition (13 respondents)	More than 15 years (9 respondents) and 1-5 years (9 respondents)

The development status of their houses was influenced by ownership status for keeping the business, and the duration of doing business. As shown in *Table 4-5*, the development status for Own House residents is ‘steadily’. It is described as such because the efforts made by both Lease House and Family Legacy House residents have been made since a long time ago, despite the ownership status of the building not being their Own House. Because of this, most of them overcome obstacles in the process of house development gradually, utilizing savings. The motivation for family members to continue production in each development status differs, but is mostly to continue tradition.

4.3.2 *Typical Vernacular Housing Pattern*

In this section, the authors try to obtain specific information about a resident’s motivation to renovate their house. The selected house is a house that has limited land and a low economic level in the case study area as shown in *Figure 4-4*. This exploration was conducted by drawing the initial floor plan based on the explanation of the owner, and then we redrew the house which is now renovated. This house plan focused on the consideration of the needs of both the living activities and business activities.

First, this study was conducted by tracing patterns of the construction of houses in Kampong Sanan. This was done to get the full background directly from residents. One family was then selected for this investigation regarding the motivation

of the construction of their house; this house was located on the inside of Kampong Sanan. In this case, the motivation for the renovations was an increase of family members.

Figure 4-4. House Plan, before and after daughter's marriage.

The pattern of house development as related to HBE changed in this house from the initial conditions to current conditions, as follows:

Previously, the house was owned by the father who was living with his children and grandchildren. His income was not enough to renovate the house. The position of the kitchen was at the back and it was last renovated in 2000 because the back of the kitchen collapsed. The results of the renovation were changes to a back room that used to be a part of the kitchen (*Fig. 4-4*). The reason to build back rooms was to add space for a married daughter. In the current condition, they built a room with limited funds, and although there remains a desire to add a room again, the plan is only for

adding to the front part of the house. They need a special room for "*leleran*" (a part of the production process for "*tempe*" making) and an expansion of the living room. They are currently using the corner of the family room for production and have plans to add a special space if they have sufficient funds in order to build up the floor where goods are put at the back of the house. The space between rooms is used for ironing and family gathering.

Further studies were conducted in houses of similar economic level residents. Based on the cases found different parts of the houses were taken into consideration during the renovation. Parts of the houses used included the kitchen, the appearance of houses, terraces, orientation and other parts. Through considering vernacular patterns, we studied the influence and the reason to do renovations (*Table 4-6*).

Table 4-6. The relationship between influencer, the reason for the renovation, and part will be maintained.

Influencers		**The reasons**	**The parts of house maintained**					**Total**
			Kitchen	**Building appearance**	**Orientation**	**Terrace**	**Others**	
Family	Reason for renovation	Facilitate business	54.2%				25.0%	79.2%
		Adding to Household		4.2%	8.3%	8.3%		20.8%
Relatives	Reason for renovation	Facilitate business		100.0%				100.0%
Neighbor	Reason for renovation	Facilitate business	75.0%			12.5%		87.5%
		Adding to Household	12.5%					12.5%

Most of the reasons for doing house improvements were to facilitate economic activity rather than to facilitate household use. This is largely influenced by neighbors (87.5%) and family (79.2%). While the part of the house being renovated is usually the kitchen. The changes to house plans vary depending on what factors they prioritize. In the early development stages, they tend to improve their kitchen to support their economic activity. Changes that occur to the houses are shown in *Figure 4-5* below (LA= Living Activities; BA= Business Activities).

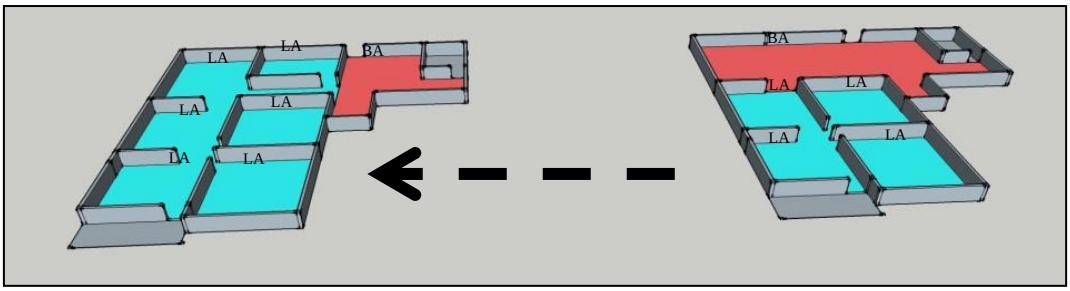


Figure 4-5. Figure regarding early development.

Note: Red for Economic Domain and Blue for Domestic Domain

This research also asked about expectations for development when land is limited, with no possibility to buy or add to the land, and while it is necessary to remain on the same property. After expansion, followed by a period of no change, they decided to steadily develop the house more. The possibilities that occur after the economic income improves are as shown in *Figure 4-6.*

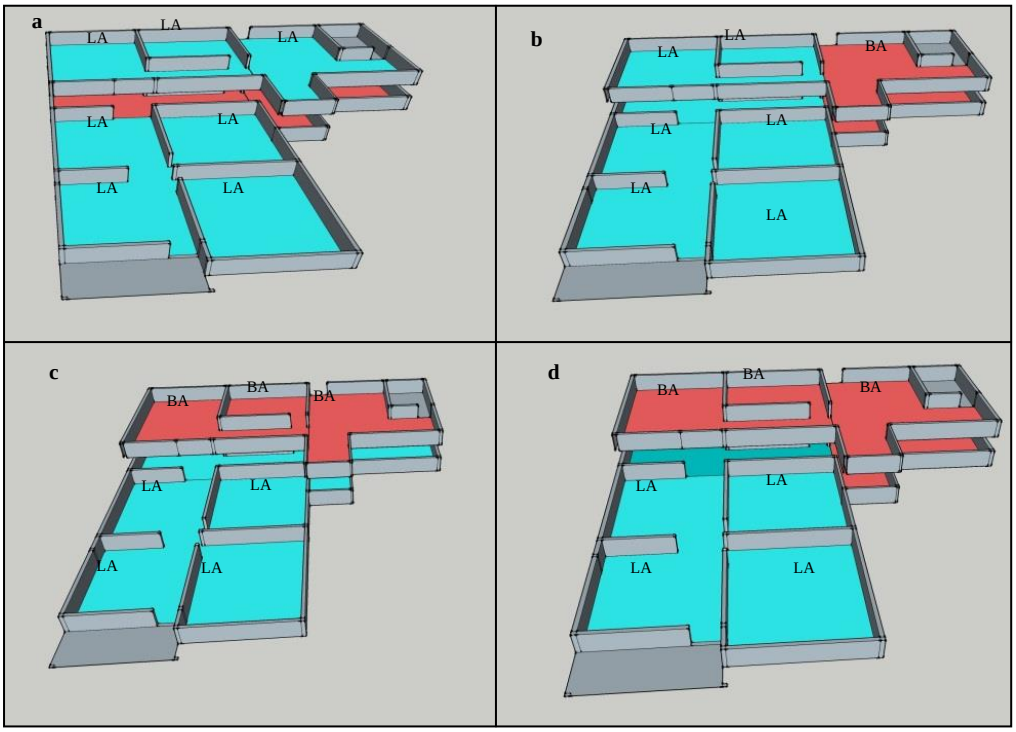


Figure 4-6. Figure regarding possible development.

a) The back of the ground floor is used for economic purposes and an additional floor added at the rear for households. b) Both the upper and lower floors are used for the economic activity. c) An additional floor at the back of the house is added for the economic activity. d) Both the side of the house and the additional floor at the rear are used for the economic activity.

Based on these patterns, in the early stages of economic development decisions were made to maximize the rear of the house as an economic activity space. Considerations led to decisions to maintain the existence of the kitchen. The kitchen has two functions, both as a place for living activities and business activities. In the next stage

of development the whole back of house is maximized, including the upper floor section for production, while the center of the house remains functioning as a living space.

4.4 Locations and Housing Patterns of HBE

Based on the analysis in above section, the locations and economic levels are important factors in determining the pattern of house development. At locations that are far away from the main road there are four alternative developments based on field observations, the pattern is often chosen by occupants. When the location is near the main road there are four developmental patterns according to the residents' economic needs.

4.4.1 *Houses located far from the main road*

In its development, the changes that occur can be of various kinds. In houses that are near the main kampong street, the front of their house is prioritized for economic activity, and the back for living activities (*Fig. 4-7*).

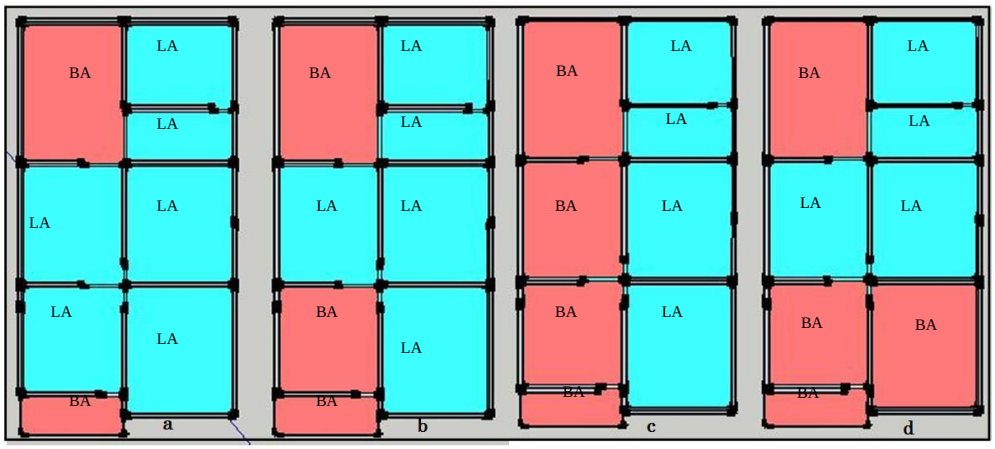


Figure 4-7. The kitchen is at the rear and is always determined as a business zone.

In addition a) The terrace is used. b) The terrace and the living room are used, and this is often a conflicting space. c) The terrace, living room, and family room are dual-purpose, greatening the chances of conflict here. d) The terrace, living room, and front room are used, which is starting to create a business zone, distinct from the living area.

Some homes in *Figure 4-7.a* only use the front of the house (the terrace), which is used for selling or production activities. Furthermore, the house has more rooms for living activities. In *Figure 4-7.b*, residents use only the terrace and living room for business activities; this situation often generates a conflict of space. In *Figure 4-7.c*, the terrace, living room, and family room are all dual-purpose, this pattern also

generates the possibility of a larger conflict of space. This happens because more rooms are involved in the business thoroughfare. The pattern of *Figure 4-7.d*, shows the business activity is carried out on the terrace, and in the living room and front room, this is caused by a business need that requires a separate room. In this pattern, the business zone is separate from the living zone.

4.4.2 *Houses located near the main road*

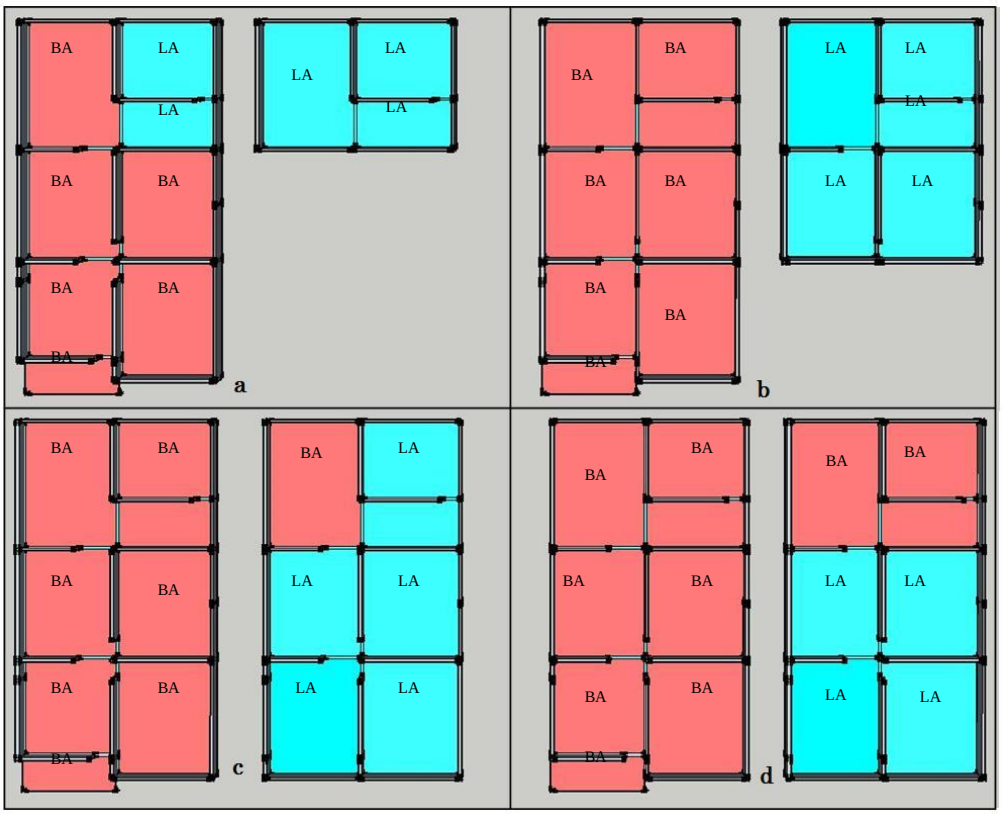


Figure 4-8. The house located near main street.

a) Almost all of the ground floor is used for the business and the added floor at the rear for households. b) The entire ground floor is used for business and the added floor at the rear for households. c) The entire ground floor and part of the upper floor at the rear are used for the business, while the top floor, extending to the front of the house, is used for households. d) The entire ground floor and rear of the top floor are used for the business and the front of the top floor for the household.

The houses that are located near the main street of the town utilize about 66% of the homes for economic activity; this causes the appearance of the store to change. Patterns that may occur are as follows (*Fig. 4-8*); *Figure 4-8.a* shows almost all of the ground floor is used for business, while at the rear one more floor is built for living activities. *Figure 4-8.b* shows the entire ground floor is used for business, while the upper part is used for living (50% of the house). *Figure 4-8.c* shows the entire ground floor is used for business activities and extends to the second floor partially, while the

upper floor is extended forward for living activities. In *Figure 4-8.d*, the entire ground floor is used for business activities and extends to the back half of the upper floor, while the front of the upper floor is used for living.

In the current conditions, the front area of the kampong grew faster into a trading place. This situation resulted in a change to the shape and spatial layout of the houses, which look like stores, although the original function of the dwelling remains. The kampong tends to adopt development patterns from the surrounding area, and the rapid development of new housing in the area around the kampong also stimulates the changes.

Some assumptions about house development can be made based on the availability of resources and what kind of opportunities is created for the repair or construction of houses. Because of the inheritance of cultural values through cross-generational business inheritance, the business of "*tempe*" practices and its resources, including houses, is sustainable. The development of the house is greatly influenced by the decision of the family to make such house developments. The business activities have a great influence on the living space when the family facilitates business activities in those areas. The existence of the kitchen remains the same, and relatives have little influence on business activities and maintaining the appearance of the house. The neighbors have more influence than the relatives on the kitchen space because they live in the same place and have the same occupation, offering a perspective that can be informative to their neighbors. Most of them choose the kitchen to be maintained for business activities.

4.5 Conclusion in this chapter

Through investigating the informal housing vernacular pattern occurring in the process of urban growth, Kampong Sanan has homogeneity as a village that produces and sells "*tempe*". Residents build houses in accordance with their economic level and the location of their home.

A research approach focusing on vernacular patterns is essential in order to know more about the needs and traditions of housing development. The questionnaire was an instrument in tracking and analyzing the patterns of house development as vernacular patterns; investigation in the case study area is useful to obtain detailed

information on the changes, the motivation to do renovations, and the expectation of available funds to build.

The location of a house will determine the pattern of the house's development from the time of building. It can be concluded that the closer to the main road the house is, the greater the opportunity to utilize the existing land to maximize business activities. It is different for people who live relatively far from the main road, they try to maximize their houses under the condition of limited space, and the respective patterns are expected to be a reference for residents who live in densely populated areas and have limited land.

The city road is a factor that accelerates change to the housing patterns, and most changes occur near the main street. House changes that occur depend on the economic level of the residents, while the reason for changes is due to business activities rather than living activities, so the part of the house relating to business activities is the part of the house that needs to be developed. Furthermore, vernacular patterns occurred based on their traditions of home and work. The housing patterns reflected the conditions required by the household and the business activity. The respective patterns are expected to be a reference for people based on the needs of their household and the business.

Chapter 5 : The Effect of Land Use Zonings on Housing Development in Indonesia

5.1 Introduction

In the case of Indonesia, every city has a Land Use Zoning (LUZ) plan for its residential. Unfortunately, until now, there is no clear boundary zone of land ear-marked for different types of residential buildings, such as a group of similarly designed houses or apartment buildings. The housing development supports the needs of the community as a manifestation of the city's economic progress, while the existing housing also needs to be maintained in order to preserve the characteristics of rural and agricultural lands as a natural resource. Beside, in achieving the co-existing of any development which is in accordance with their respective development patterns, they should consider about a clear drawing line. It is necessary to control land use using LUZ. In the regulation of LUZ in the suburbs, a lot of rules on parcels are an important part as a tool for local planners to restrict land use in high density or to control growth and preserve open space and farmland. As a result, the home owner-based housing and natural resources are not optimally preserved. In order to achieve that, it requires a study about a clear boundary about the allocation of land for a residential zone.

The land use plan is a tool of urban planning to control the provision of land and buildings (Mark and Goldberg (1986)) and Land use is also a major factor for people who support the socio-economic development in rural areas. (Borges, Fragoso, et al. (2010)). The Government of Indonesia establishes LUZ in less detail on each zone, so that planners can plan what kind and type of building should be constructed. The effect of LUZs often occurs in the border area between the cities, such as the case in Surabaya and Sidoarjo. The conditions in the field show that the home owner-based housing displaced by the project-based housing development. If this condition contin-ues then the whole residential area will disappear and the natural aspect will be lost as well. The zoning needs a strict boundary line between project-based housing and

home owner-based housing use in LUZ and through LUZ will be helpful to support both housing in order to achieve sustainable urban form in the urban fringe area.

Another discussion is about confliction between economic and existing conventional life; Local Government is the decision maker to determine a local land use policy on housing provision. Assche and Djanibekov (2012) said that land use policy issues continue to integrate economic and environmental land use development, arguing that land use planning is used as a tool to find a good integration. On the contrary, the establishment of a special land use zoning for the residential were not differentiated for housing development, this resulted in the expansion of project-based housing development in the home owner-based housing area. In the home owner-based housing has a lot bigger land, because it still need a large yard, and most in the urban fringe area still have large amounts of land for agriculture (Yokohari, Brown, et al. (1994); Haregeweyn, Fikadu, et al. (2012); Amsalu, Stroonijder, et al. (2007)). In the case in Sidoarjo city, most of them have a vast land, and they have paddy field and ponds. Price of paddy land and ponds is relatively cheap. The relative phenomenon also has been discussed in other studies as follows: land use transformation tend to take profits, the developer buys their land for new residential development to increase of private land for new comers (Tse (2001); Sullivan (1984); Weaver and Lawton (2001); Shahraki, Sauri, et al. (2011)). The developers improve public infrastructure and social services, however, without available land use control.

From the view of social equality between developer and local residents, we suggest that land use zoning is a possible tool to keep co-existing of project-based housing development and home owner-based housing in the urban fringe area in order to achieve the traditional residential area as a sustainable form in the urban fringe area. Because most Indonesians are generally reluctant to stay in a lot of storey buildings, but prefer to live in a house with a yard. Thus, it leads the developers' preference to build residential parcels rather than apartments. It is also caused by psychological factors, which are about the satisfaction of living. Discussion on the satisfaction scale based on human behavior and high-rise buildings (Marmot (1983); Lewis (1997); Chuo and Lee (2011); Wang and Chien (1999)), the development should be built on the premise of the human scale and residential perspective. Under these conditions, Indonesians are more comfortable staying in private housing rather than flats. If we assume that the desire is the demand of the market, this will be the consideration for planners and developers in Indonesia's preference to build private housing. Other

aspect is suburban areas has become popular area for economic development (Haughton (1997); Magliocca, McConnell, et al. (2012); Wu and Webster (1998); Grieson and White (1981); Wallace (1988)). In Indonesia, competition for land in the region has increased significantly in the 1990s. Land is much cheaper than land in the city center, and many industries are built in the suburbs.

There are many new developments in Northern Sidoarjo because Surabaya's sprawl. Some discussions about urban sprawl; if it continues, then the most of the natural environment will be destroyed. Based on some study of land use zoning in urban fringe areas, there are some issues that arise in the environment on urban fringe areas, such as land degradation, ecological issues, and financing (Nellis and Maca (1986); Tai-Yang, Xian-Jin, et al, (2011); Saint-Macarya, Keil, et al, (2010); Zhang (2001); Zhao (2010); Lestrelin (2010); Aguilar and Santos (2011); Gennaio, Hersperger, et al, (2009); Poelmans and Rompaey (2009)). In this area, the pattern of mixed use urban development makes the existing planning should be adjusted to the facilities already built before, so that mixed use city are expected to be achieved. Housing developments in this area give effect to the existing housing and environment. The sustainable urban form is not achieved because the traditional residential environment is occupied by housing development gradually. The sustainable development for traditional housing should be interrelated between economy, society and ecology in order to keep developments going well.

This chapter discusses the LUZ, which will be helpful to support project-based housing development, home owner-based housing, and explain the impacts of LUZ in the urban fringe area. It's compiled in three sections. First section, it presents the facts on housing and its development in Sidoarjo, which have significant implications for the provision of housing development. In the second section, it examines urban growth in the border area between the two cities and the changes in housing around that area due to housing development. The last section contains the conclusion section which highlights the role of LUZ between project-based housing development and home owner-based housing development.

5.2 Approach

This chapter is the review for effects of LUZ on housing development in Sidoarjo city. The sampling was taken in the border area of Surabaya and Sidoarjo. Data took

from the local government documents, housing developers, and Tambaksumur village officers. The field data took from the interviews and photos are able to map out the situation there. The existing zoning does not distinguish between project-based housing development and home owner-based housing, so that should be examined. The steps in this research is to conduct a review of the implementation of LUZ in Indonesia and later explored more in the application of land use zoning in border cities of Surabaya and Sidoarjo.

Understanding both project-based housing development and home owner-based housing condition are important in order to understand patterns of Land cover and land use change as well as their social and environmental implications at different spatial and temporal scales (Lopez, Boccoa, et al. (2001); Firman and Dharmapatni (1994); Firman (2002); Firman (2004)). Land cover were influenced by historical land policies, protected area management as well as regional power structures, land use histories, local culture, affordability, the socio-economic conditions and community involvement are important in evaluating and understanding land cover change (Muriuki, Seabrook, et al. (2011); Sivam (2002)).

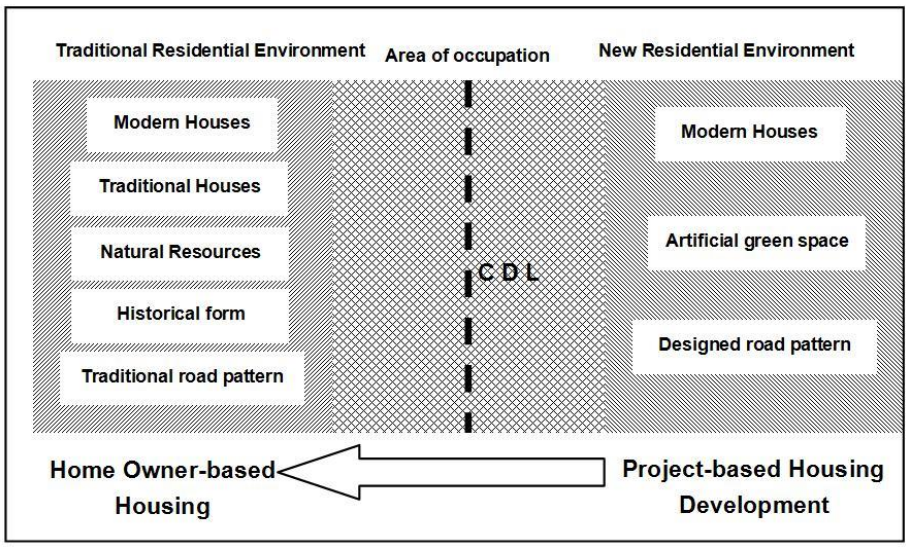


Figure 5-1. Diagram of occupation by project-based housing development on home owner-based housing.

The parcel of home owner-based follows the geographical conditions and the existing road as a reference in its construction, while the parcel of project-based housing development created by the planner in accordance with the design of housing built. In the mixed use development, the parcel coordination should occur at LUZ, resulting in harmony between the project-based housing development and home owner-based housing. In the allotment of land for housing, the traditional residential environment is

expected to be used as a basic pattern of the new residential environment (*Fig.5-1*). Through the traditional residential environment we can create drawing lines for the optimal construction of project-based housing development, can determine the shape of the line, and can determine the shape of the border areas. The line is the divider between the two types of development called Co-existing Dividing Line (CDL). In order to determine the shape of the CDL, the patterns of the original traditional residential environment should be known in advance, including the things contained in the border areas such as agricultural land, house yards, and roads. Some factors for considering to CDL and differences between the two environments are shown in *Table 5-1* below.

Table 5-1. The factors for CDL in home owner-based housing and project-based housing development.

Factors	Home Owner-based Housing	Project-based Housing development
Housing parcel	Natural parcel	Designed parcel
Housing type	Design by house owner	Designed by planner (a group of people, company, government)
Road system	Follow the topography of land (natural)	Designed by planner to provide housing demand
Green open space	Natural green space and its a part of living support for house owners (agriculture, fish ponds)	Artificial green space (play ground, park)
Topography	Topography of housing was following the natural surface.	Topography of housing area is designed by planner.
Historical form	Has historical or sacred venues (grave yard)	Does not have
Public building	It provide by local government	It provide by developer
Housing demar-cation	Natural form such as meadow, fields, paddy land, river.	Artificial form such as fences, wall, gate, canal, row of vegetation.

Some factors contained in the home owner-based housing and project-based housing development needs to be defined in advance, because it should be considered when making the CDL. Some aspects of the housing are used to the basis for the determination of these factors;

1. HS= Housing shape (loop, cluster, linear, cul-de-sac)
2. HT= Housing type (Luxury, simple, traditional)
3. HDL= Housing demarcation line (in meters).
4. EPBS= The existence of public buildings and social facilities (shopping, education, health, work, worship).

5. PR= The presence of roads (arterials, collectors, local)
6. UL= Utility lines (water, waste water, rain water disposal, garbage disposal, electrical grid, telephone network).
7. GOS= Green open space (parks, playgrounds, agriculture, aquaculture)
8. TP= Topography (rivers, valleys, hills)
9. HF= Historical form.

These factors are the basis for the determination of CDL, to what extent is the area that allowed for housing development. This chapter is noticeable that the CDL is the set of coherent planning between project-based housing development and home owner-based housing and it is expected that every planning should pay attention about CDL. If the factor has been determined, then it adjusted based on the existing map. Thus factors are considered in housing development planning. Any points that allow for development are determined factors of its CDL, thus it can make clearly which part are considered for housing development.

There are 3 important actors which contribute on this situation, that are government, community, and developer. Zoning is also used as a reference for the development of parcels with clear boundaries between project-based housing and home owner-based housing (*Fig.5-2*).

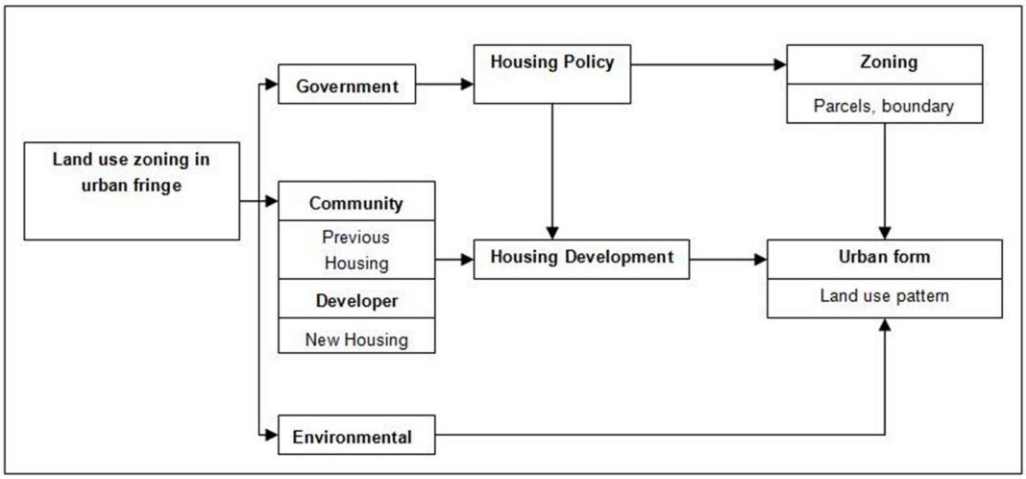


Figure 5-2. Diagram of Housing development in urban fringe.

Furthermore, step review conducted are: first, studying LUZ in the border areas in the two cities, observing zone intended for housing as well as the surrounding zones designated for industrial development and the CBD; Second, the analysis points are the growth and traffic patterns in the border area. This analysis also describes the history of the growth of project-based housing developments derived from statistical

data; Third, an analysis of the conditions at the housing in one of the areas in the border region; Fourth, discuss the impact resulting from project-based housing developments in the home owner-based housing area; Fifth, make recommendations for decision-makers, planners, and developers for the next development.

5.3 Zoning System of Indonesia

The Indonesian government set the National Spatial Plan (NSP), as well as all cities in Indonesia has NSP. NSP is further elaborated in City Detail Spatial Plan (CDSP), through Regional Development Planning Agency (it is called as BAPPEDA) that establishes land use zoning with two main criteria for the development of the developing zone and conservation zone. In *Figure 5-3* the flow of planning system is shown from the national to the cities. The dashed line on the chart shows the parts are studied in this work.

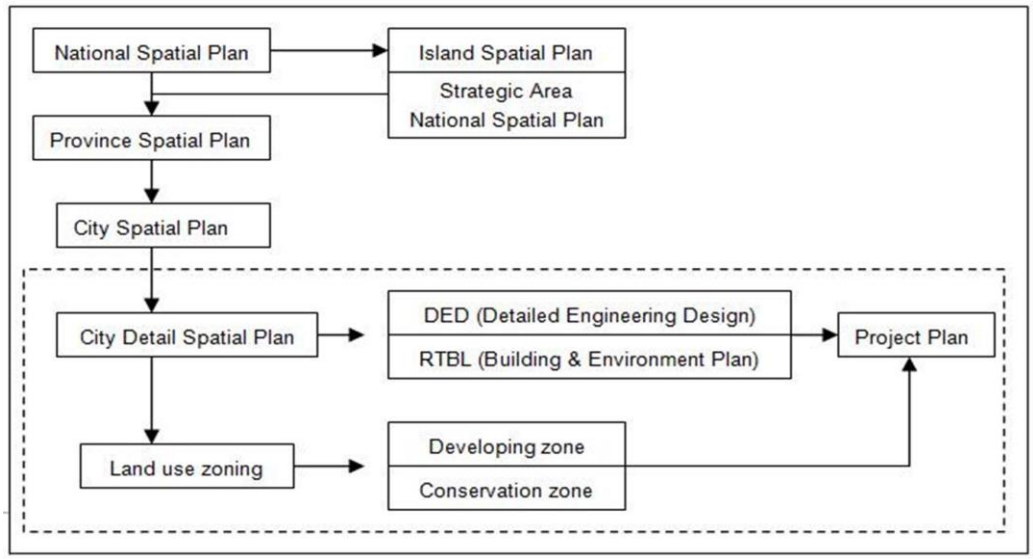


Figure 5-3. Diagram of spatial planning system in Indonesia.

There are several zones are generally defined in LUZ in Indonesia, including: public facilities, residential, offices, trade and services, agriculture, military, industrial, vacant land, farms, forests. Especially in residential zone there is no specific zone between the housing development and the existing residential area that must be maintained. The government of Indonesia has had the rules listed in the National Rules for the residential area of Indonesia, is to evaluate the proposed plan and synchronize activities and changes associated with compliance with national priorities (Housing Minister of The Republic of Indonesia Number 30 Year 2011), but there is

no the technical regulations for the construction of housing development. The situation is different with other countries such as Japan. Japan uses 12 (twelve) categories of LUZ provide zoning land use patterns in each type of urban areas. It can be generally categorized into residential, commercial and industrial use. Each LUZ have specifications regarding the use of the building that can be built in the zone; especially for residential zones are grouped into 7 (seven) categories (Ministry of Land, Infrastructure and Transport, Japan, 2003). This categorization will facilitate planners in planning, thus reducing the overlap between home owner-based housing and project-based housing development.

Economic growth of Indonesia led to the increasing demand for housing. The construction of project-based housing development often occurs in the border area between cities; this condition is often related to issues of governance, as when cities expand beyond their administrative boundaries (WUP 2005). Based on data from the WUP 2011 (World Urbanization Prospects: The 2011 Revision), the Average Annual Rate of Change of the Rural Percentage by Major Areas in Indonesia was -1.58% in 2010-2015 and Percentage of Population Residing in Urban Areas is 50.7% in 2011 and 53.7% in 2015. It shows there is a decrease in the rural areas. Most of the land development spread to the rural areas and creating urban sprawl (Winarso and Firman (2002)).

5.4 Local Government Policy

The government operates a location permit system and a land ownership right and tenure conversion system in the launching of every real estate company development project (Archer (1994); Datta and Jones (2001); Shahraki, Sauri, et al., (2011)). The policies taken by most of local government in Indonesia are as follows: 1) the planning process begins with the preparation of city development strategies based on City Spatial Plan, 2) preparation of a medium-term investment program; 3) raising funds, 4) preparation of a pilot model of development, 5) increasing the ability of city government officers (Policy and National Strategy for Housing and Settlement of Indonesia (KSNPP)). The government uses the policy to promote the development, one is in establishing zoning. The emergence of these policies and strategies against the background due to the preparation of directives for the implementation of housing and settlements which have existed since Repelita V (five years development plan-

ning step); the National Housing Policy and Strategy is not considered appropriate, so it is necessary to arrangements and the handling of the integrated housing and settlements.

Table 5-2. The recovering area for the development of residential.

Area	Percentages
Surabaya city	62,36 %
Sidoarjo district	26,88 %
Malang city	3,98 %
Gresik city	3,48 %
Malang district	2,38%
Other cities	0,92 %

Source: Office of National Land Agency of East Java, the data obtained in 2003

The national policy consisting of three basic structures is related to the institutional, housing needs, and achieving quality settlements. While the strategy to implement the policies formulated especially to be able to achieve significant strategic substance of each policy. The existence of development policy made Sidoarjo District in 1993 going 'boom', permitted the location in the 1993/1994 year, where the amount of land given to the developer (it is called as REI) covers an area of 2219.80 ha. This amount represents the second largest East Java for residential development area (*Table 5-2*).

5.4.1 *Land use zoning in Sidoarjo-Surabaya, Indonesia*

Based on urban land use plan of Sidoarjo, Sidoarjo regency is divided into 5 Sub Regional Unit Development (RUD), District Waru is in RUD-I, which have the priority development of industry, trade, services, and education. Planning area is included in the CDSP Waru district, Sidoarjo regency. Waru sub divided into residential areas, industry, trade, services, agriculture, conservation, and fishery. Regard to the direction of urban development, which tends to follow the linear pattern of road network from North to South and West. While in the western and eastern sectors there is the tendency for housing and industrial development. Seeing this condition Waru district is at a very strategic location because it is directly adjacent to the city of Surabaya, so as to support trading and settlement, especially since it is supported by transport infrastructure as a linkage system (*Fig. 5-4*).

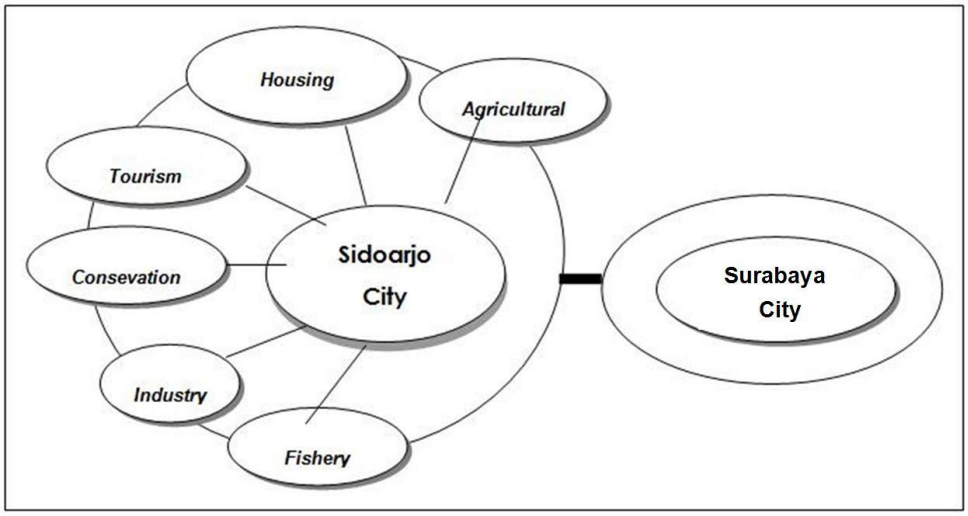


Figure 5-4. Linkage system between Sidoarjo and Surabaya.

Source: Sidoarjo City Master Plan 1984-2004

The existing land use patterns in Waru district is divided into 2 parts:

a. Development areas which include,

1. The use of land for housing
2. The use of land for office
3. The use of land for public facilities or social
4. The use of land for industrial or warehousing
5. The use of land for services
6. The use of land for Trade.

b. The Conservation Area

This area includes mangrove forests along the coast (east region), greening line along the river border, along the highway, along the railway tracks.

Generators such as industrial and road infrastructure are the main triggers rapid housing growth and uncontrolled.

5.4.2 *Expansion Development*

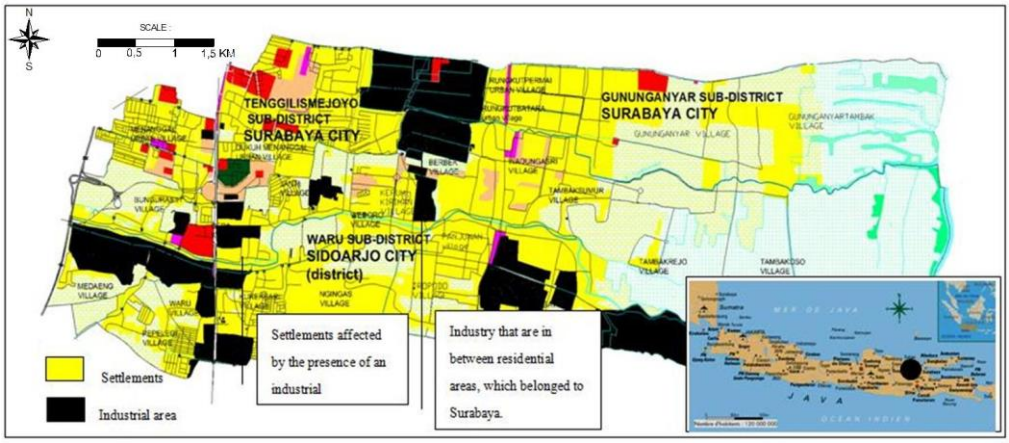


Figure 5-5. Industrial and Settlements Condition between Surabaya-Sidoarjo area.

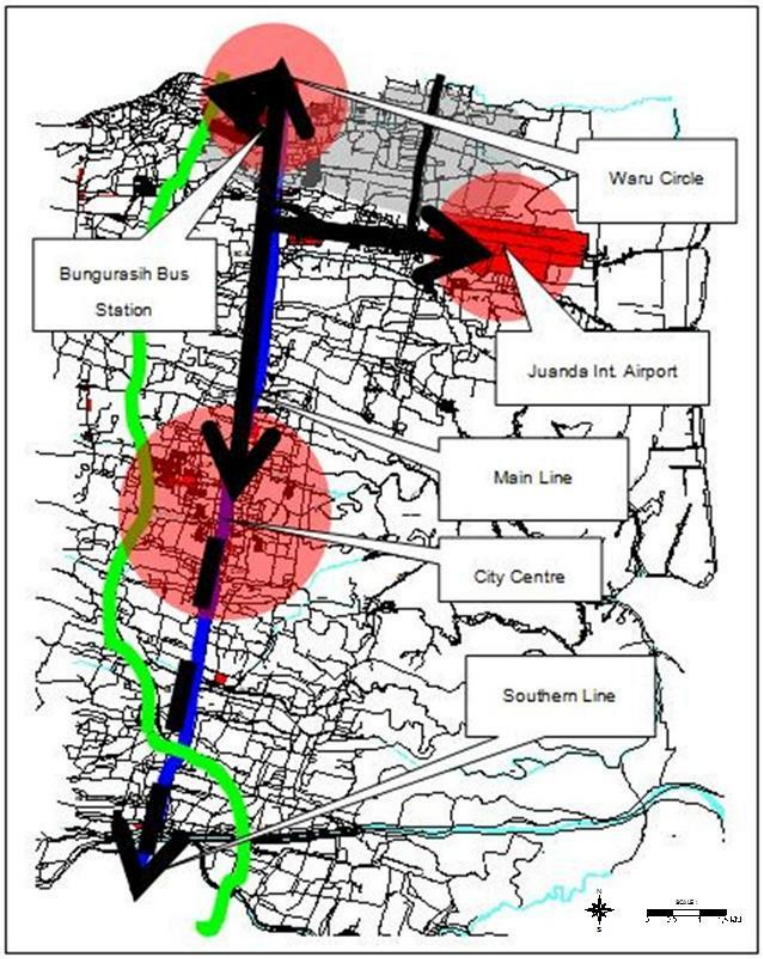


Figure 5-6. The Trigger of City Development.

Expansion development of Indonesia cities is happening largely through administrative boundaries. In the case of Surabaya-Sidoarjo as a corridor, this phenomenon was happened because fast growth city of Surabaya. The color code use yellow for determining the settlement's area. The zoning for residential land is not distinguished

for different types of residential buildings, such as project-based housing development built by developer and house owner-based houses maintained by residents. There are no clear boundaries between them on the map (*Fig. 5-5*). Waru sub-district was divided into settlements, industrial, commerce, services, agriculture, and ponds. City growth direction tend to linear that is follow northerly road network pattern to North-South and West. The West and East area for the housing and industrial sector: Waru sub-district is at very strategic position because direct to Surabaya border, so it can support especially commerce and settlements because supported by structure and infrastructure of transportation (*Fig. 5-6*).

Table 5-3. Growth generator in Sidoarjo from 1970-2000.

No	Year	Generator
1	1970	PT. Panggung Electronics Industry
2	1970	PT. Maspion I.
3	1971	Aloha restaurant
4	1974	PT. Astra /Toyota
5	1981	Civil flight at Juanda airport
6	1984-1986	Secondary road at Southerly Gedangan-Surabaya lines
7	1993-1998	Secondary road at Northerly Gedangan-Surabaya lines
8	1994	Utami Hotel
9	1999	PT. Pitamas Indonusa (adhesive industry)
10	1996	PT. Sinar Djjacan (Tin Plate press industry)
11	1997	Juanda Gas Station
12	1999	PT. Indomarco (rubber industry)
13	2000	PT. Golden Ruberindo (ketchup industry)
14	2000	Started to produce PT. Cipta Plastindo (plastic industry) and also a lot of business centre and also infrastructure)

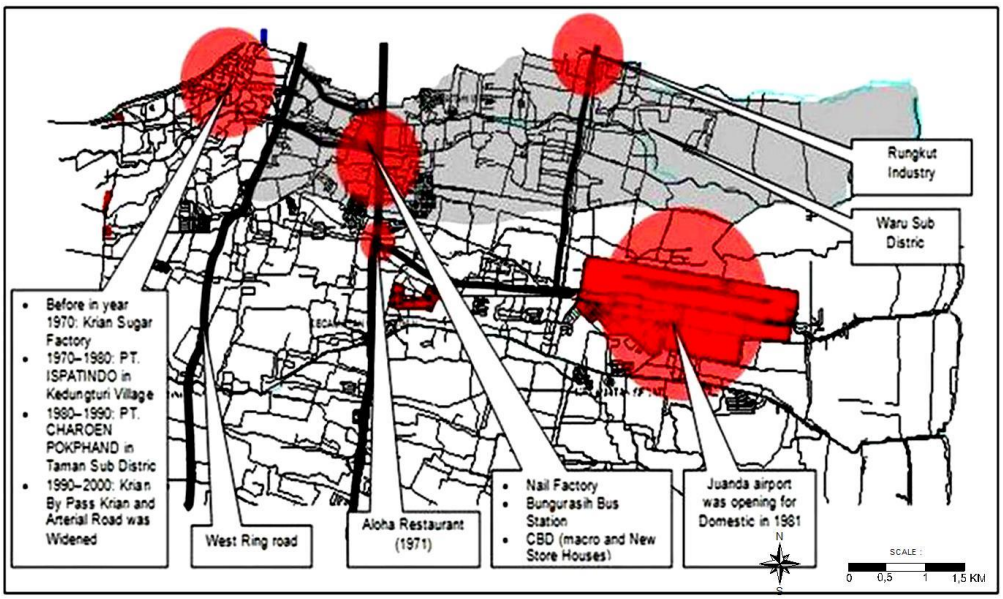


Figure 5-7. Growth generator at Waru-Surabaya, Gray area indicates the spread of housing and the color red is the focal point of growth.

The types of land use from farm were changed to settlements and industrial use caused by road infrastructure and transportation system of Waru-Krian area (*Fig. 5-7*). The connection of this area to other cities by primary-artery representing province road, and also collector road from outside Taman-Krian makes the lines tend to grow. The accessibility become easy with other area and accelerates city growth. There is also a connecting corridor between Surabaya-Gempol as accessing to Tanjung Perak Port and Bungurasih bus station in Waru (*Fig. 5-8*). This indicates that the Sidoarjo city is a supporter of the Surabaya city, coupled with the limited land presence in the city of Surabaya.

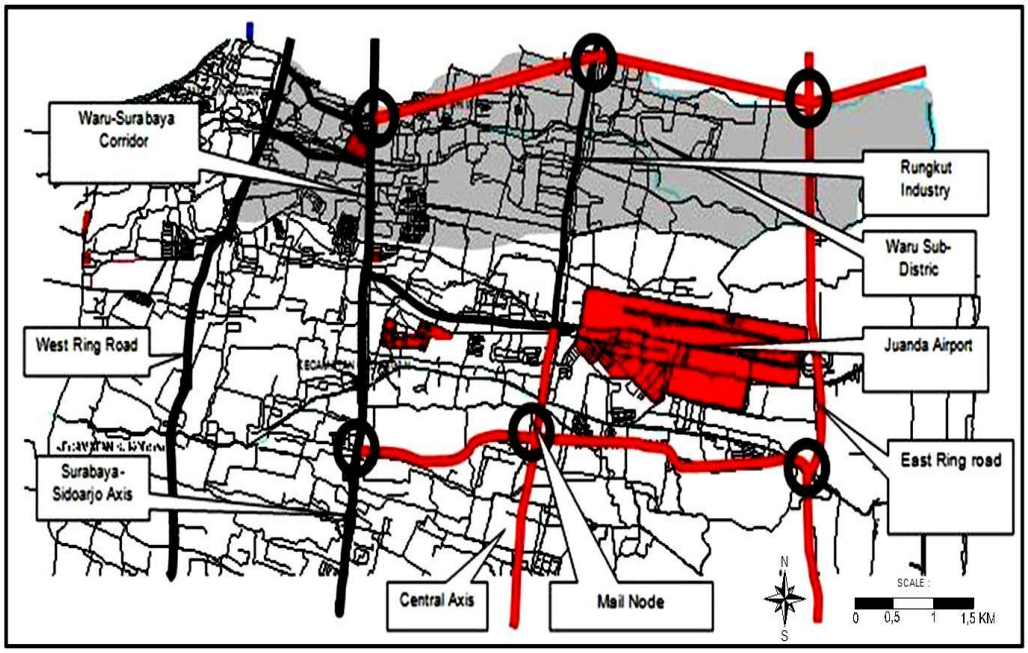


Figure 5-8. The road patterns surround Waru-Surabaya

Red line shows the road network plan and the black lines indicate the presence of existing roads. Block color red is the area of the CBD (Central Business District).

The Generator from industry and road infrastructure represent primary factor of project-based housing development growth. It give an overwhelming impact on housing; growth quickly and un-control. Industrial and road infrastructure were underdeveloped before in year 1995 and rapidly grow and also very fast in the year 2000 (*Table 5-2*). It already planned in the LUZ map in the border area in Surabaya and Sidoarjo (*Fig. 5-9*).

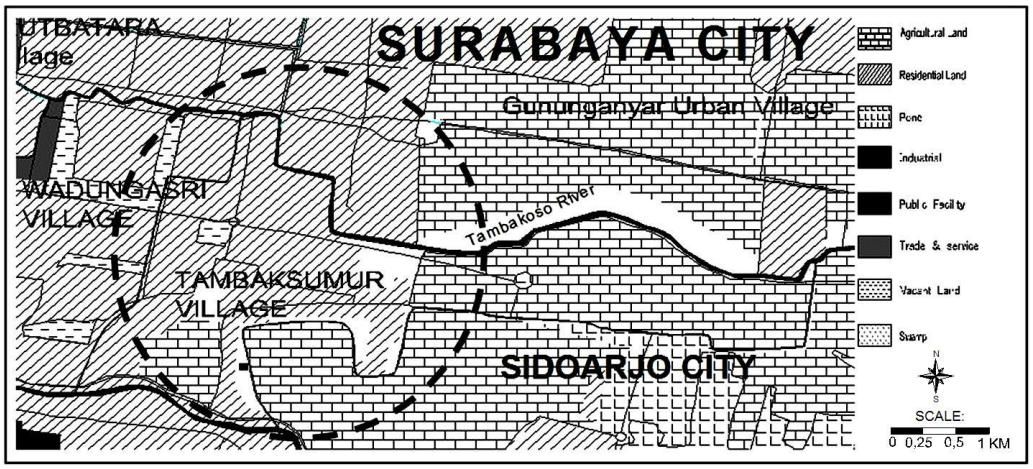


Figure 5-9. Zoning plan at Tambaksumur Village.

5.4.3 *Existing Condition in Tambaksumur Village*

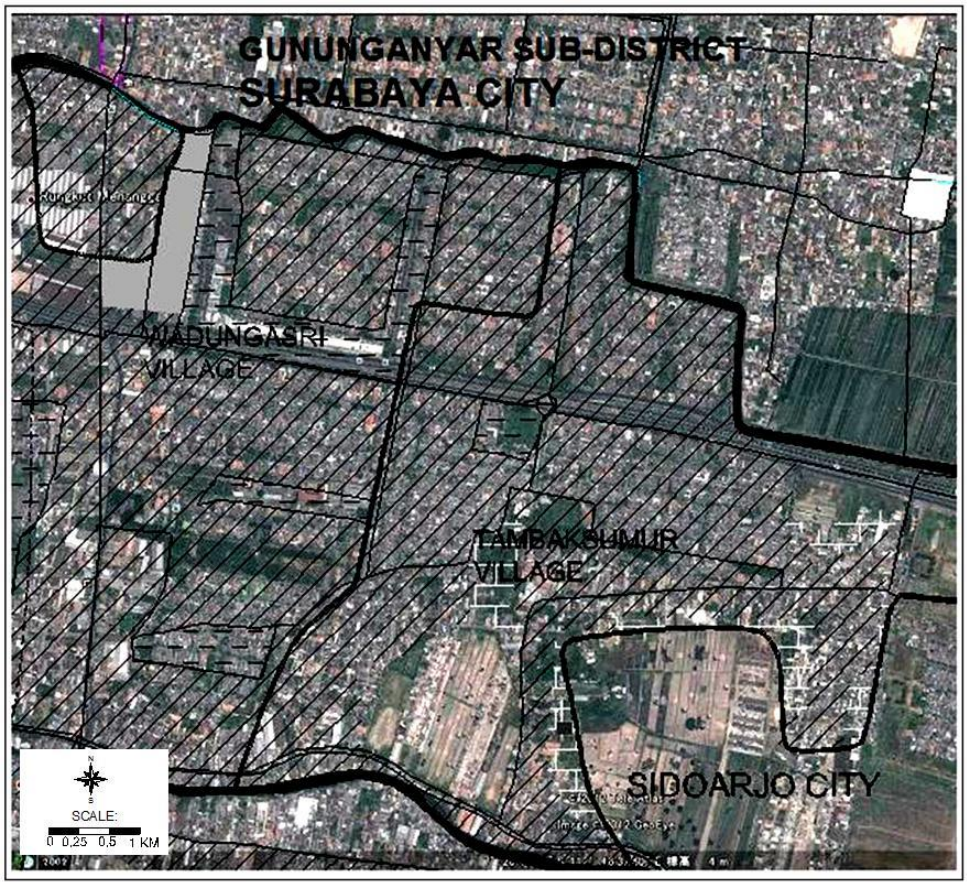


Figure 5-10. Land use zoning in Tambaksumur Village area (combination of aerial photo layer and land use maps).

Regard to *Figure 5-10*, the designations marked on the map are for residential land use, so that housing developments legal to build. Tambaksumur village located on the border of the city of Surabaya while the location of housing development is administratively located in two cities, it looks the difference between the patterns of

the home owner-based housing and project-based housing development from aerial photographs (*Fig. 5-11*).

Figure 5-11. Aerial photographs of formal housing and informal housing (Pondok Tjandra Indah & Village Tambaksumur, Sidoarjo City).

This contradiction is indicated by the orientation of the building, each guided by the road. The project-based housing looks "grid pattern", while, "linear pattern" is used by home owner based housing by following the path. That condition is an interesting phenomenon, because the home owner-based housing gradually tends to follow the grid pattern used by project-based housing development next to them. According to Steadman (1983) development of a form cannot be separated from the science of morphology. Morphological studies are studies looking for developmental forms. Development of the physical form occurs through two processes namely: the "formal process" (through the process of planning and design), and organic process (a process that is planned and developed by itself).

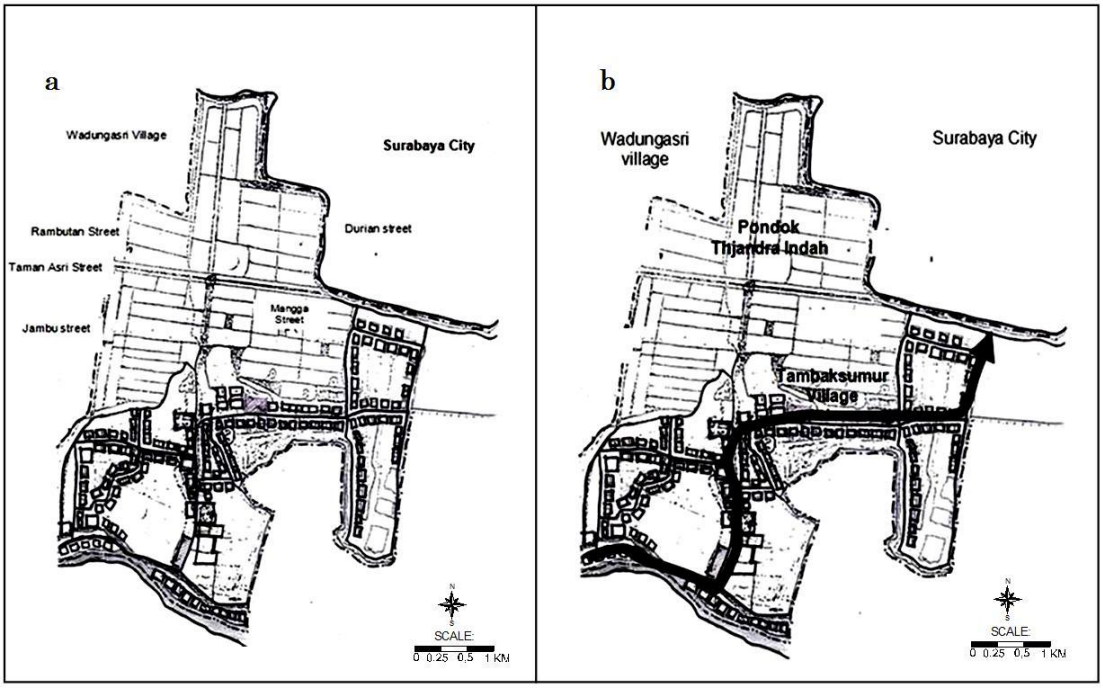


Figure 5-12. a). Different Pattern between Tambaksumur Village and Pondok Tjandra Indah Housing (PTIH). b) Housing Pattern (linear) of Tambaksumur Village.

In accordance with the case in the Tambaksumur village and Pondok Tjandra Indah Housing (PTIH), located in District Waru, Sidoarjo regencies are very fast progressing. This is due to its location next to the city of Surabaya, which is directly or indirectly affected by the development of the Surabaya city. This situation is giving out a major influence on housing and settlement sector (*Fig. 5-12.a* and *Fig. 5-12.b*). Changes in housing in Tambaksumur also occurred on the road pattern, due to opening access connecting the two areas. This triggers the construction of grid model in Tambaksumur area (*Fig. 5-13*).

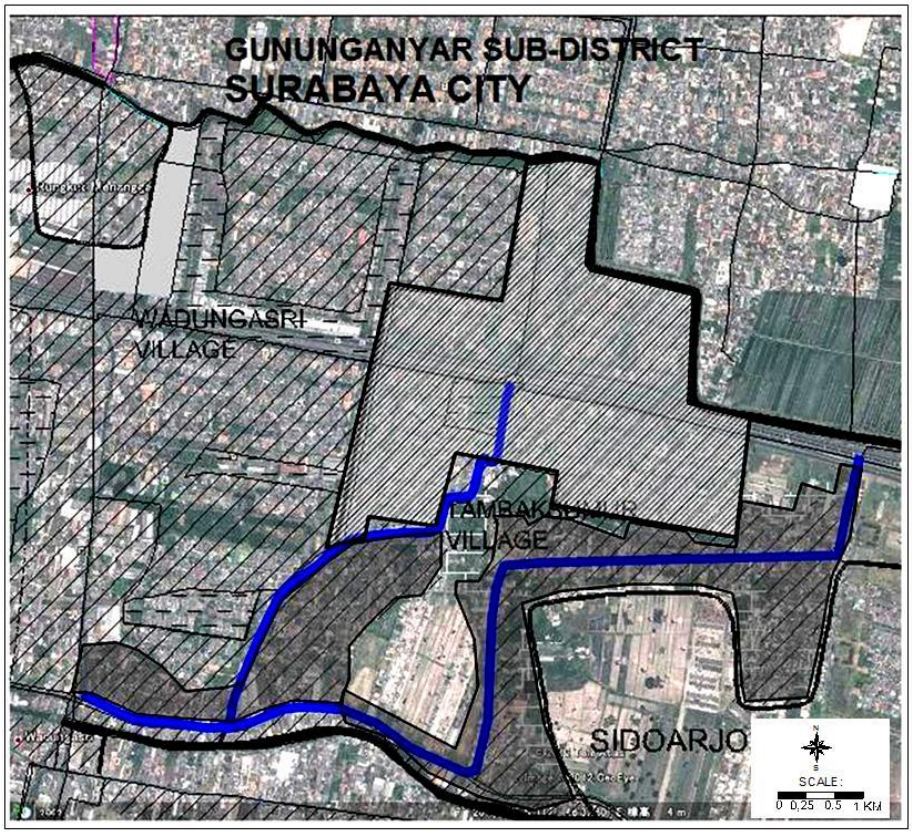


Figure 5-13. The main road that is influenced by project-based housing development, which is indicated by access connecting both housing areas.

5.4.4 *Pattern of Housing Parcels*

The development of the housing naturally from the pattern of the physical arrangement of residential buildings that follow the access road and there are some of the houses that are not oriented directly towards the road (*Fig. 5-14*). Linear pattern is due: The main road linking between the West-East villages and the building houses mostly oriented on the main street of the village.

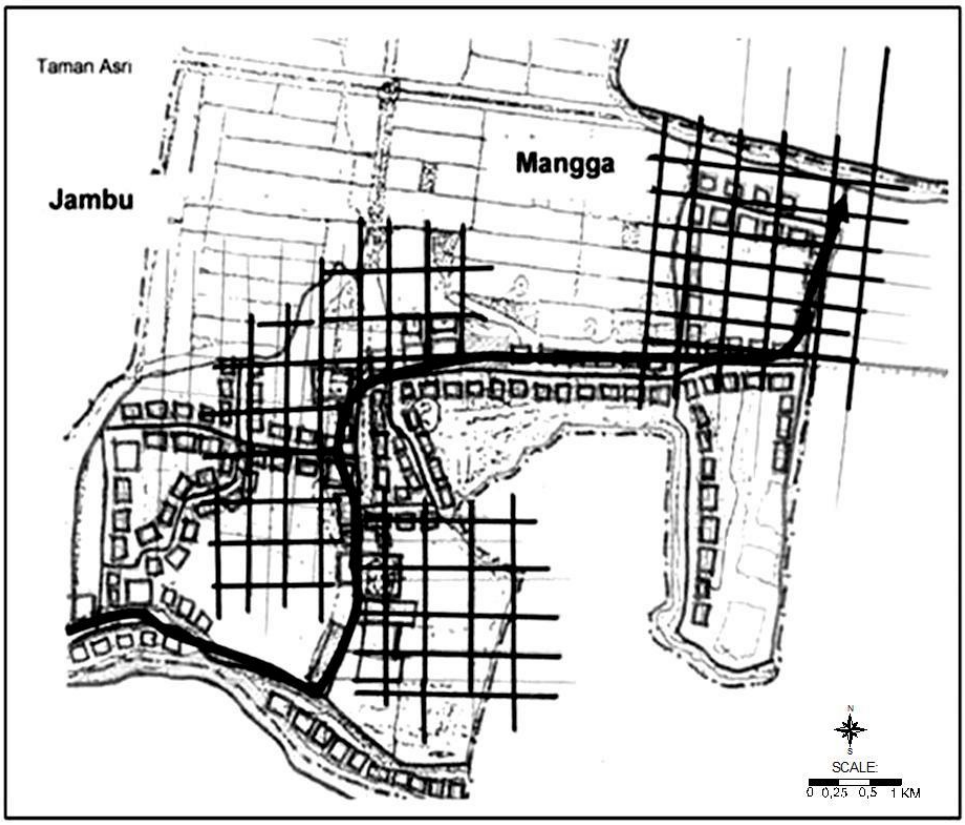


Figure 5-14. Grid and Linear Pattern**.**

The trend of the Tambaksumur village leads to the grid, where new houses are built to utilize the land and the yard which are not productive. The agricultural lands still maintain to meet the consumption of agriculture (mainly rice). Later, there is a combination between grid and linear (*Fig. 5-15*). Project-based housing development gives effect to home owner-based houses nearby. This orientation appears on the houses and road are built close to the project-based housing development. The grid of project-based housing development had influence to the development of Tambaksumur village.

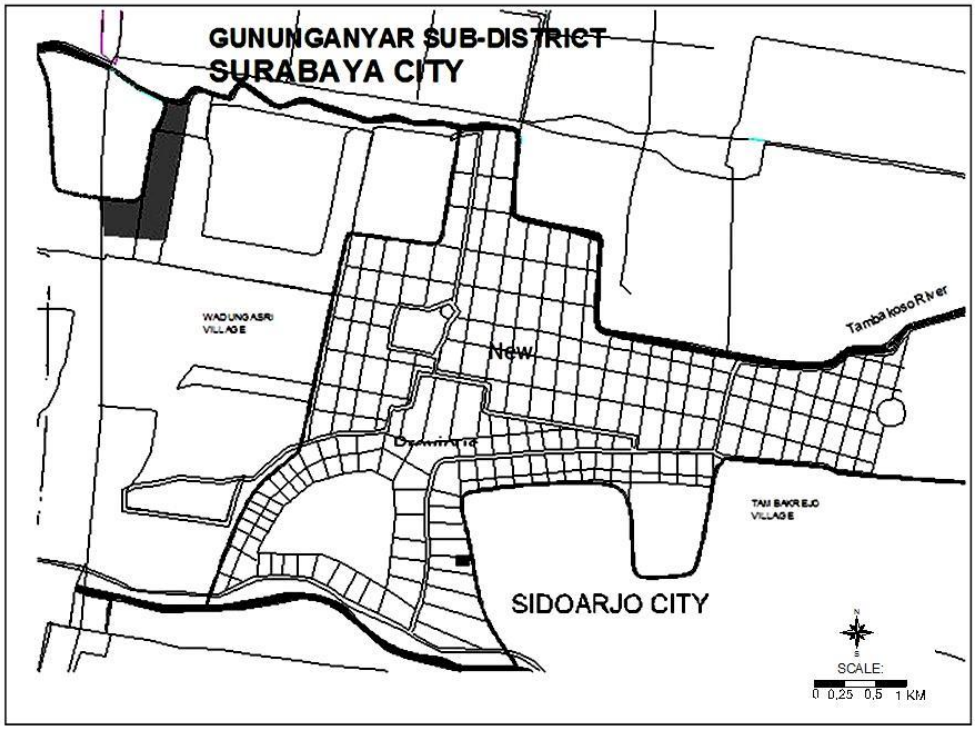


Figure 5-15. The difference between project-based housing parcel patterns and home owner-based housing.

The existence of the access road which is connecting with project-based housing development in Northern side follows the pattern of residential streets at PTIH. By comparing to the map in 1963 (*Fig. 5-16*) with a current situation, the houses and main roads in the Tambaksumur village, in which:

- The road network is a linear pattern of the North-South direction.
- The existence of houses was along the main street of the village.
- There were rice fields around the Tambaksumur village.

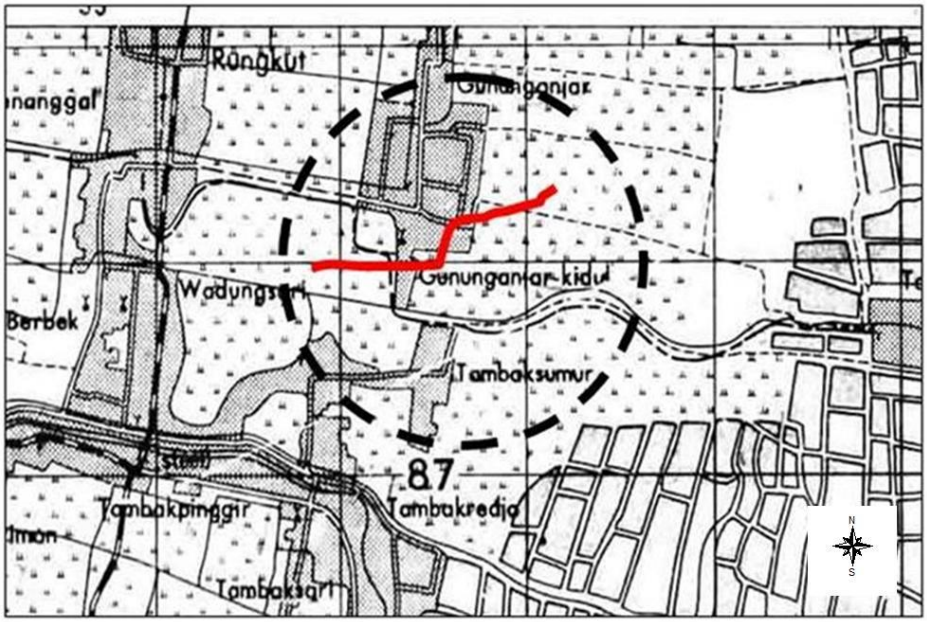


Figure 5-16. The map of District Waru, Sidoarjo, 1963**.**

Source: Bureau of structure and infrastructure on Settlement Development Project, East Java.

5.5 CDL in Tambaksumur Village

To determine the CDL in this area carried out several steps. Once we know the boundaries between project-based housing and home owner-based housing (*Fig. 5-17*), then the next step is to determine the factors contained in home owner-based housing, and then choose the optimization area that could be used as a development boundary of project-based housing development, and each home owner-based housing has different factor depending on location.

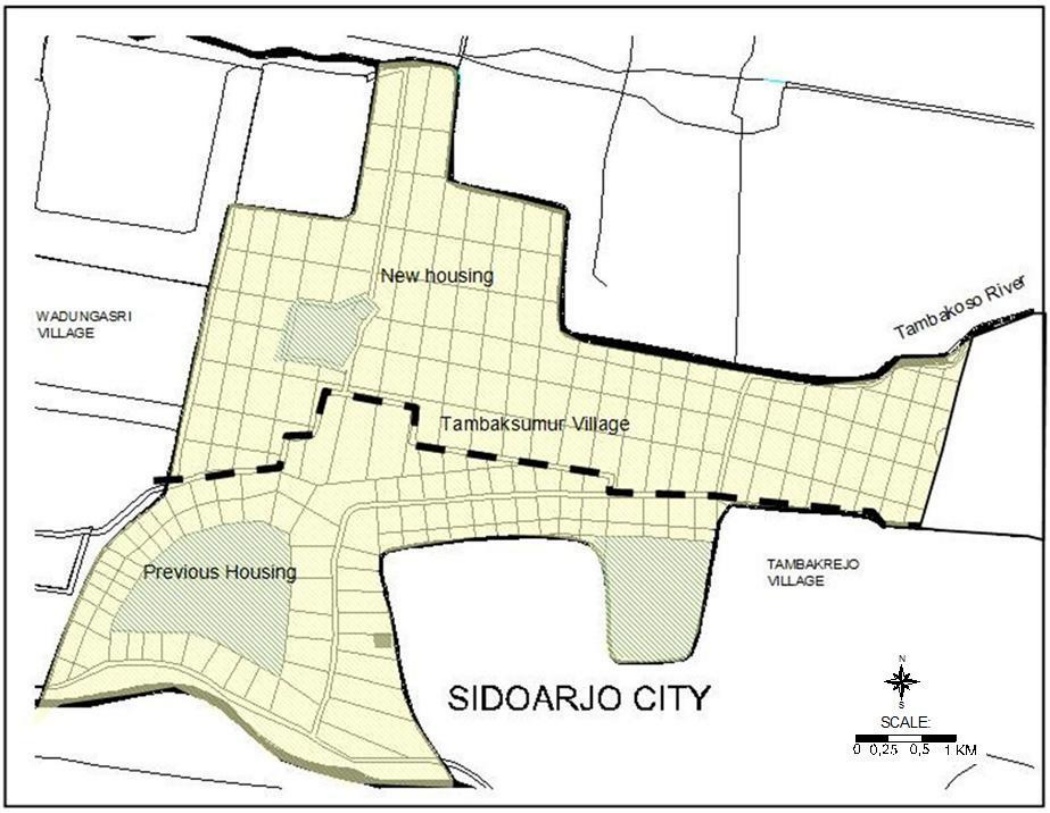


Figure 5-17. The boundary line in the same colour coding scheme on residential use parcel.

Priority factors become important in determining the factors of the decision which will be inserted into the CDL (*Table 5-4*). The factors should adjacent to the border areas between cities. In the case of Tambaksumur village there are several factors as follows:

Table 5-4. Aspect of CDL on Tambaksumur.

No	Factors	Determination of Tambaksumur	CDL
1	HS	Linear	Considered
2	HT	Traditional	Considered
3	HDL	3 m	Considered
4	EPBS	Being in the middle of the village / not on the border.	Not considered
5	UL	Power lines, rain water drainage, waste disposal, telephone network	Considered
6	PR	Collectors road and Local road	Considered
7	GOS	Aquaculture, farm.	Considered
8	TP	The river located on the South side, not in border areas.	Not considered
9	HF	Not being in border city	Not considered

The land use map is the most common of the land-based presentation of data. In general, land use is shown in a different color. The map illustrates the land use effectively use the concept of land-uses graphic displays, roads, public infrastructure,

and community facilities. This standard is also often recommended for planners in many countries. But there is a deviation in the planning and implementation, specifically on the residential use on the land use map in Indonesia does not distinguish tagging for project-based housing development. Because the color coding scheme used is already commonly used in every plan, then it is ignored. Developers do not have a guide to distinguish the extent to where they should not do development under land use control of local government.

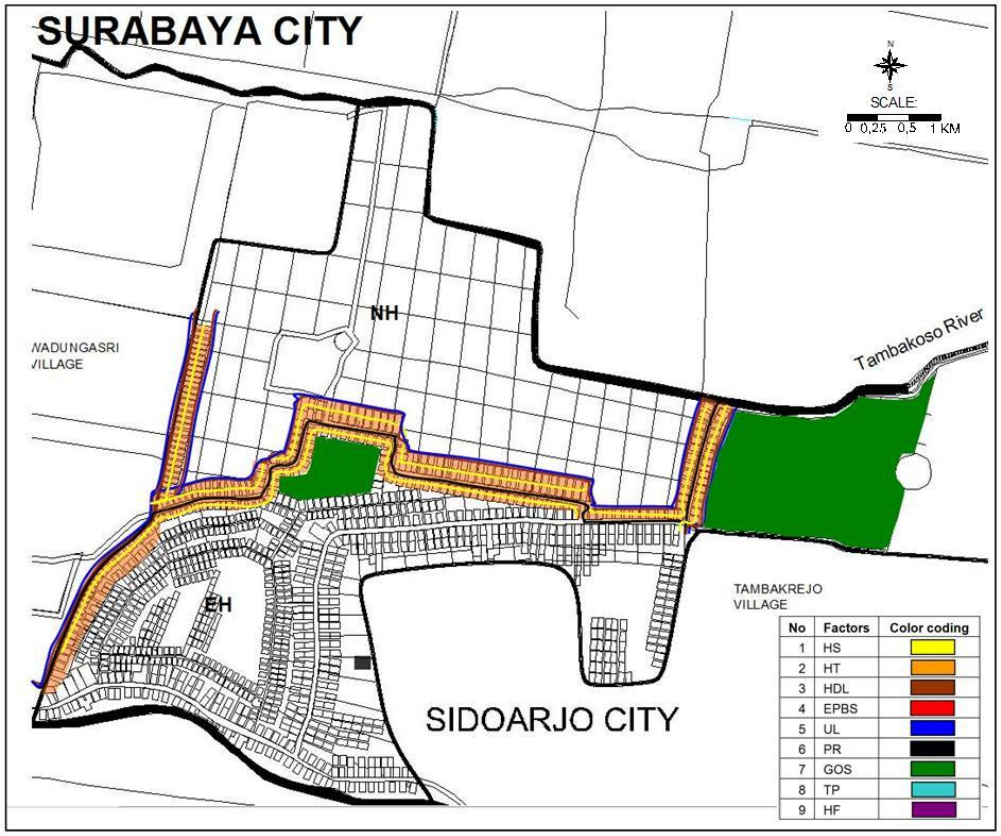


Figure 5-18. The CDL factors on housing development in Tambaksumur village.

Figure 5-19. The CDL factors in every part of home owner-based housing.

Therefore, in addition to the notation used color coding scheme for the determination of residential use is also required a clear boundary line between project-based housing development and home owner-based housing (*Fig. 5-18* and *Fig.5-19).* This should be done starting from the survey in the field in the existing mapping which will be translated in the process of making land use maps.

5.6 Discussion

As we know that every development is essentially based on economic considerations, similarly, the housing development. Economic development in the city of Sidoarjo, and particularly in sub Waru is rapidly increasing by the industrial sector, which in turn requires the need for the housing provision. The growth on Tambaksumur village and PTIH affected by the Surabaya development, this requires the role of the various parties involved in the development of housing on the basis of economic development. Tambaksumur village is strategic for the development in the housing

sector. This development was also influenced by the urban development and housing in the surrounding area.

Baharoglu and Leitmann (1998) in their research about the strategies for infra-structure, they suggests that home owner-based housing built by the resident itself will have an impact because of unplanned by professional planners, but by owner itself. It led to be uncontrolled in terms of design and building quality. In addition, in a formal estate planning does not include planning for home owner-based housing. "*The process of housing transforming has many different kinds of motivation, among Socio-culturally, growth of family size, generating income, response to harsh climatic conditions, and desire to copy prevalent housing forms*" (Shiferaw 1998). Furthermore, for the home owner-base housing, the transformation of the traditional housing is not due to one single factor but because many factors, where economy plays the main role (Al-Naim and Mahmud (2007)). According to Bredenoord and Lindert (2010) when self-help housing processes are in the initial stage, the quality of the houses is often low and in many cases cannot even speak of it as a 'house'. Communities try to build his own home in stages. They are not doing so directly, but through various stages. This can be seen from the form of houses being occupied at this time. Various types and styles used to build their homes. They adopted the style of a residential building next to their areas. So it can be concluded that the construction of houses in Tambaksumur not appear by itself, but caused by projet-based housing development next to its areas.

The propject-based housing development and home owner-based housing are influenced by the city development. Each effect is shown in the process of building their houses. Kombe and Kreibich (2000) also have an opinion on project-based housing development and home owner-based development is "the limited resources available to the public sector for land management and service delivery require a reorientation of urban planning concepts and measures towards strategic fields of intervention." Until now the development of this method is done, both project-based housing and home owner-based housing. The pattern of this construct can made an example for the newcomers and old residents who live in the area.

5.7 Conclusion in this chapter

In particular, project-based housing development can be followed by zoning, but there is no clear zoning in residential areas. Government on Indonesia does not have clear zoning statutes for residential development, so, developers easily create new residential parcels. In this area, there are many village houses with extensive agricultural land.

CDL on LUZ is effective in achieving co-existing development on border area. All developments should be referred, even the project-based housing development itself. It is used as a guide for developer and policy maker to develop in regional areas. The concept of residential development in line with the development of rural areas and housing depending on the actor because the actor plays the greatest role in business development of settlements. Executors include government, private, joint community, and individuals. The effort of community for the procurement of housing is now affected by the residential development of the private sector, fewer lands to build houses, high land prices increased highly; this is what causes the deployment of the housing at the present time.

Commercial approach on project-based housing development emerged due to the opportunities of economic that exist in the area where the business interest has. A change was designated originally for residential. That mixed use, even in the most receptive locales, has become desirable as long as it is confined to certain zone and does not disturb the existing residences (Hirt (2007)). Furthermore, the new dwellings may be allowed by the existing shops, but the opposite is not deemed a viable possibility. The paddy fields were changed into housing and following the direction of the municipality. Many choices are made to conserve, the solution is taken also vary. But the important thing is how to co-exist on any housing construction.

There are several aspects that will keep the harmony between project-based housing development and home owner-based housing. To achieve harmony, it takes good coordination between the private sector, public sector, and society. Furthermore, each area has different characteristics, particularly in the area between the two cities. Both of these areas should inquiry each other and maintain their form. To achieve that, it is necessary to set clear boundaries by CDL in LUZ for residential zones. This CDL will help local governments and developers in planning and designing facilities and

infrastructure between two cities. When this is accomplished it will achieve sustainable urban form in the urban fringe area.

Chapter 6 : Conclusion

In this PhD research we use space syntax, vernacular approach and review LUZ plan, and this research is useful for determining Residential housing Development in Indonesia from the Perspective of Sustainable Urban Form. As a research for planning support of sustainable urban form, we took three intentions of urban development as our focus. Respectively they are, spatial arrangement of houses, vernacular of house development, and effect of Land Use Zoning on Housing Development.

In term of the products of city planning, it have become the major objectives in spatial strategic plan in Indonesia. Indonesia still requires a long process and the role of urban planning and urban design has a very large role in the effort to realize sustainable urban form in the city. Besides, implementation of green city design in Indonesia is still facing very complex issues, including socio-cultural problems, economically and politically. This research report is expected to assist policy makers in the planning and design of the city.

The population growth can be seen the completion of a significant housing problem and to direct understanding of the various parts of a house is considered essential. The spatial arrangements and cultural phenomena are needed to understand the relationship between space requirements in house. Based on research field with the increasing development of Yogyajarta city, spatial arrangement of Javanese House will be helping to support housing construction and arrangement of the room for Javanese family. The facts on RFYP show that despite the limitations of land, most of the inhabitants still have respect for the rules of Java are embodied in the arrangement room in the house. The depth of room will determine the importance of the position of a room. By knowing the ratio of the depth of a room, it can be seen how the residents follow the Javanese culture. Based on this ratio can also be seen that the living room has high flexibility. This means occupants more freely arrange the room as a living room. Meanwhile, the family room has a low flexibility, as it is considered very important for the Javanese family. This is in accordance with the Basic Javanese House who put the family room as important room, and also its position in the middle of the house.

Moreover, investigating the informal housing vernacular pattern occurring in the process of urban growth which took in Malang city has homogeneity as a village that produces and sells "*tempe*". Residents build houses in accordance with their economic level and the location of their home. Focusing on vernacular patterns, we need to know more about the needs and traditions of housing development. The location of a house will determine the pattern of the house's development from the time of building. It can be concluded that the closer to the main road the house is, the greater the opportunity to utilize the existing land to maximize their house based on business activities. It is different for people who live relatively far from the main road, they try to maximize their houses under the condition of limited space, and the respective patterns are expected to be a reference for residents who live in densely populated areas and have limited land. The city road is a factor that accelerates change to the housing patterns, and most changes occur near the main street. Furthermore, vernacular patterns occurred based on their traditions of home and work. The housing patterns reflected the conditions required by the living activities and the business activities. The respective patterns are expected to be a reference for people based on the needs of their living and the business.

In particular, project-based housing development can be followed by zoning, but there is no clear zoning in residential areas. Government of Indonesia does not have clear zoning statutes for residential development, so, developers easily create new residential parcels. In this area, there are many village houses with extensive agricultural land. CDL on LUZ is effective in achieving co-existing development on border area. It is used as a guide for developer and policy maker to develop in regional areas. Executors include government, private, joint community, and individuals. The effort of community for the procurement of housing is now affected by the residential development of the private sector, fewer lands to build houses, high land prices increased highly; this is what causes the deployment of the housing at the present time.

Commercial approach on project-based housing development emerged due to the opportunities of economic that exist in the area where the business interest has. A change was designated originally for residential. The important thing is how to co-exist on any housing construction. There are several aspects that will keep the harmony between project-based housing development and home owner-based housing. To achieve harmony, it takes good coordination between the private sector, public sector, and society. Each area has different characteristics, particularly in the area between

the two cities. Both of these areas should inquiry each other and maintain their form. To achieve that, it is necessary to set clear boundaries by CDL in LUZ for residential zones. This CDL will help local governments and developers in planning and designing facilities and infrastructure between two cities. When this is accomplished it will achieve sustainable urban form in the urban fringe area.

For future work, this spatial arrangement of house development should be improved to other types of house. The type of house is not limited in Indonesia only, but it is expected work on other countries as well as CDL should be improved in detail of aspects that should be assessed. In order to achieve that, is need to collect technical data and building code data from authorized city plan to provide better accuracy for determining CDL. Other thing is making the guide line for better understanding for local government and planner about spatial arrangement of house development and CDL to achieve sustainable urban form.

Residential Land use and Housing Development in Indonesia from the Perspective of Sustainable Urban Form is a comprehensive study on solving the problems that often occur as a result of urbanization taking place in the world. One of effects of urbanization is changing the urban form, this study started from the level of spatial planning, parts of houses, housing patterns, and border areas can be solved. This will help governments, planners, designers, and the public to understand the housing development to achieve sustainable urban form.

Publications:

Respati, W. and Tutuko, P. (2013). "Green City Planning and Design Approach for Global Warming Anticipatory: Case study: Surabaya's Development Plan", *The Proceeding of Workshop on Urban Planning and Management*; *"Low Carbon City in Chinese Cities"*, Kanazawa, pp. 151-173, Feb.18-20, 2013.

Respati, W. and Tutuko, P. (2013). "Planning Review: Green City Design Approach for Global Warming Anticipatory: *Surabaya's Development Plan* ", *International review for spatial planning and sustainable development*, Vol.1 No.3 (2013), pp. 4-18, ISSN: 2187-3666 (online), Copyright@SPSD Press from 2010, SPSD Press, Kanazawa. Doi: http://dx.doi.org/10.14246/irspsd.1.3_4.

Tutuko, P. and Shen, Z. (2013). "Vernacular Pattern of Housing Development on Home-Based Enterprises in Malang, Indonesia", *Proceeding of International Conference 2013 on Spatial Planning and Sustainable Development , Tsinghua University, Beijing, 15 pages, 30 Aug.-01Sept. 2013.*

Tutuko, P. and Shen, Z. (2014). "The Spatial Arrangement of Javanese House; *Case study: Residential area along the fort of Yogyakarta Palace, Indonesia", The Proceeding of 2014 workshop on urban planning and management:* "Sustainable Low Carbon Society", Kanazawa, pp. 56-70, Feb. 7-8th, 2014.

Tutuko, P. and Shen, Z. (2014). "Vernacular Pattern of House Development for Home-based Enterprises in Malang, Indonesia", *International Review for Spatial Planning and Sustainable Development Vol. 2 (2014) No. 3 p. 63-77*. Doi: http://dx.doi.org/10.14246/irspsd.2.3_63

Tutuko, P. and Shen, Z. (2014). "The Spatial Arrangement of House to Achieving Sustainable Urban Form; Case study: Residential area along the fort of Yogyakarta Palace, Indonesia", *The Proceeding of First International Symposium on Regional Sustainable Development (The 1st ISoRSDev)*, 19th June, 2014, Universitas Merdeka Malang.

Appendix:

A. Data from Respondents

Low Depth House (LDH)

No	1	2	3	4	a	b	c	d	5	6a	6b	7a	7b	8a	8b	Total Depth	dlr	dfr	dk
a4		1	1	1	1	2			1	1		1				9	0.11	0.11	0.11
e20		1		2	2				2	2						9	0.11	0.22	0.22
d6		1		1	3				2	3						10	0.10	0.10	0.20
b4		1		1	2				2	3				1		10	0.10	0.10	0.20
a6		1		1	2				3	4						11	0.09	0.09	0.27
c1		1		1	2				2	3				2		11	0.09	0.09	0.18
e13		1		1	2				2	2		2		1		11	0.09	0.09	0.18
e9		1		1	2	3			1	2	2					12	0.08	0.08	0.08
d9		1		2	3				1	3				2		12	0.08	0.17	0.08
b1		1		1	2				2	3				4		13	0.08	0.08	0.15
e2		2	1	3	3				2	2						13	0.15	0.23	0.15
d8		1		1	1	3			2	3		3				14	0.07	0.07	0.14
a7		1		1	2	3	2		3	2						14	0.07	0.07	0.21
c5		1		2	3	3	1		1	3						14	0.07	0.14	0.07
e8		1		2	3	4			1	3						14	0.07	0.14	0.07
b3		2	1	2	3				2	3		2				15	0.13	0.13	0.13
c15		1		1	2	2			2	2		2		3		15	0.07	0.07	0.13
d1		1	2	1	4				4	3						15	0.07	0.07	0.27
d2		1		1	4				2	3		2		2		15	0.07	0.07	0.13
d5		1		1	2	3			2	2				4		15	0.07	0.07	0.13
b2		1		2	3				1	4				4		15	0.07	0.13	0.07
b5		1		2	1	4			3	4						15	0.07	0.13	0.20
d10		1		1	2	3			2	3		3				15	0.07	0.07	0.13
e5		2	1	2	3				3	4						15	0.13	0.13	0.20
e21		1		2	3	4			1	3				1		15	0.07	0.13	0.07
																Total	2.18	2.79	3.81
																Mean	0.09	0.11	0.15
																DR	2.90	1.24	1.27

Medium Depth House (MDH)

No	1	2	3	4	a	b	c	d	5	6a	6b	7a	7b	8a	8b	Total Depth	dlr	dfr	dk
b10		1		1	2	3			2	3				4		16	0.06	0.06	0.13
e15		1		1	2	2			3	3		2		2		16	0.06	0.06	0.19
b6		1		1	2				2	4		2		4		16	0.06	0.06	0.13
c3		1		2	2	3			4	3				1		16	0.06	0.13	0.25
c12		1		2	3				3	3				4		16	0.06	0.13	0.19
e3		1		1	2	3	3		2	2		2				16	0.06	0.06	0.13
e23		1		2	3				3	4		3				16	0.06	0.13	0.19
d7		1		1	2				1	4		4	3	1		17	0.06	0.06	0.06
b8		1	2	1	2	3			4	4						17	0.06	0.06	0.24
e12		1		2	3				3	4				4		17	0.06	0.12	0.18
e19		1		2	2	2			2	2		3		3		17	0.06	0.12	0.12
c7		1		2	1	2	3		3	3				3		18	0.06	0.11	0.17
c13		1		1	2	4			3	3				4		18	0.06	0.06	0.17
e4		2	1	2	2	3	3		3	3						19	0.11	0.11	0.16
b7		1	2	1	3	3			3	3				3		19	0.05	0.05	0.16
c4		1		2	3	3	4		1	2				3		19	0.05	0.11	0.05
c10		1		1	2	2	3		4	3				3		19	0.05	0.05	0.21
c14		1		2	1	2	3		4	3				3		19	0.05	0.11	0.21
d4		1		1	4	4			3	3				3		19	0.05	0.05	0.16
e17		1	2	3	3				3	3				4		19	0.05	0.16	0.16
a3		1	2	1	2	2	3		3	3				3		20	0.05	0.05	0.15
a8		1		1	2	3	2	2	3	3				3		20	0.05	0.05	0.15
d12		1	1	2	2	2			3	5				4		20	0.05	0.10	0.15
e7		1		2	2	1			3	4		2	5			20	0.05	0.10	0.15
e16		1	2	1	2	2			3	3	3			3		20	0.05	0.05	0.15
e22		1	2	2	2	3			3	3		4				20	0.05	0.10	0.15
a1	0	1	4	3	4	4			1	4						21	0.05	0.14	0.05
a2	0	1	4	3	4	4			1	4						21	0.05	0.14	0.05
a5		1		2	3	2			3	3		3		4		21	0.05	0.10	0.14
a11		1	2	2	4	2	2	2	3	3						21	0.05	0.10	0.14
b9		1	2	3	2	3			3	3				1	3	21	0.05	0.14	0.14
c2		1	2	1	3				3	3		4		5		22	0.05	0.05	0.14
c6		1		2	3	3	1		4	4		3		1		22	0.05	0.09	0.18
c9		1		2	2	2	3		3	3		3		3		22	0.05	0.09	0.14
d3		1		2	3	4			3	2		4		3		22	0.05	0.09	0.14
e6		2	1	3	4	5			2	2		3				22	0.09	0.14	0.09
e11		2	1	2	3	3			4	5		2				22	0.09	0.09	0.18
																Total	2.11	3.39	5.50
																Mean	0.06	0.09	0.15
																DR	1.90	1.02	1.24

High Depth House (HDH)

No	1	2	3	4	a	b	c	d	5	6a	6b	7a	7b	8a	8b	Total Depth	dlr	dfr	dk
a10		1	1	2	2	3			3	4		3		4		23	0.04	0.09	0.13
e10		2	1	2	3				3	3		5		4		23	0.09	0.09	0.13
e1		1		2	3	4	4		3	3	2	1		1		24	0.04	0.08	0.13
e14		2	1	2	2	3	4		3	3		2		2		24	0.08	0.08	0.13
d11		1		2	3	4	4		3	3		4		1		25	0.04	0.08	0.12
a9		2	1	3	4	3			5	5				5		28	0.07	0.11	0.18
c11		1	2	2	4	4			4	5				1	5	28	0.04	0.07	0.14
e18		1	2	3	2	3	4		3	4		3		4		29	0.03	0.10	0.10
c8		1	2	3	4	3			3	6		4		5		31	0.03	0.10	0.10
																Total	0.47	0.80	1.15
																Mean	0.05	0.09	0.13
																DR	1.74	0.99	1.07

Codes	Rooms
1	Terrace
3	Corridor
4	Family Room
a	Bed room
b	Bed room
c	Bed room
d	Bed room
5	Kitchen
6	Toilet
7	Warehouse
8	Wash & Dry

B. Statistic Data

Statistics

Total Depth

		Statistic	Bootstrap[a]			
			Bias	Std. Error	95% Confidence Interval	
					Lower	Upper
N	Valid	71	0	0	71	71
	Missing	0	0	0	0	0
Mean		17.86	.07	.60	16.42	19.03
Median		17.00	.58	1.18	15.84	19.00
Mode		15				
Variance		22.523	-.326	3.872	14.575	31.144
Range		22				
Minimum		9				
Maximum		31				
Sum		1268				

a. Unless otherwise noted, bootstrap results are based on 71 bootstrap samples

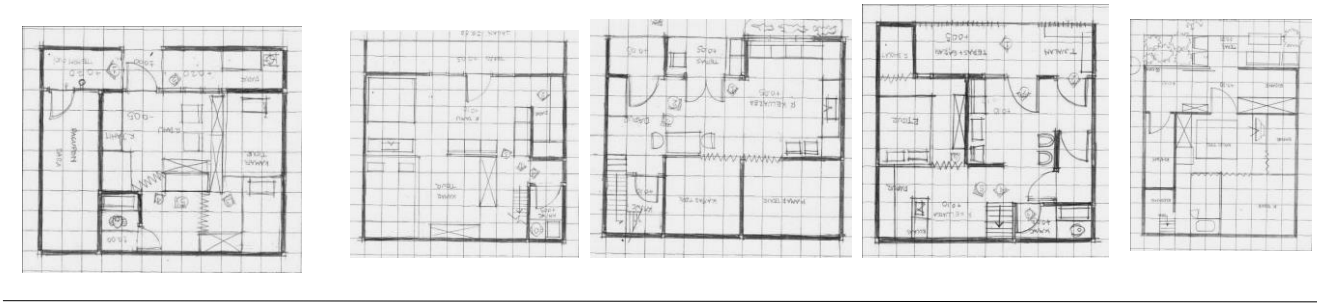
Total Depth

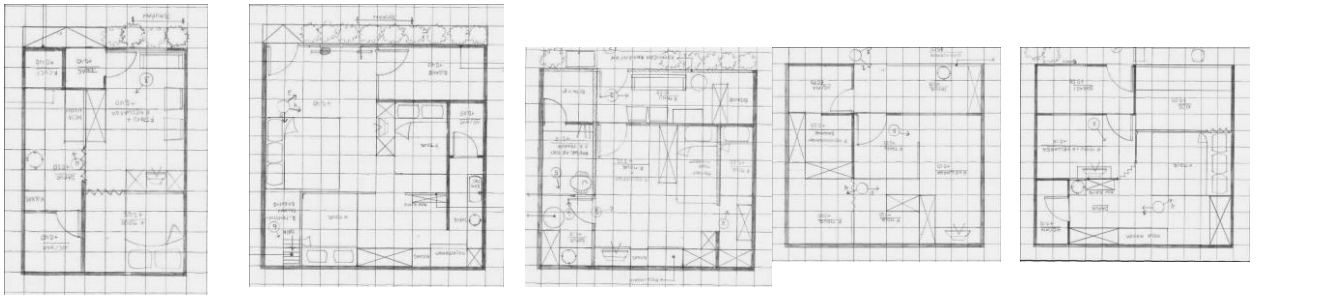
		Frequency	Per-cent	Valid Percent	Cumulative Percent	Bootstrap for Percent[a]			
						Bias	Std. Error	95% Confidence Interval	
								Lower	Upper
Valid	9	2	2.8	2.8	2.8	-.5	1.6	.0	5.9
	10	2	2.8	2.8	5.6	-.2	2.1	.0	7.7
	11	3	4.2	4.2	9.9	.7	2.9	.0	11.5
	12	2	2.8	2.8	12.7	.0	2.0	.0	7.7
	13	2	2.8	2.8	15.5	-.1	1.8	.0	7.0
	14	4	5.6	5.6	21.1	-.3	2.7	.0	11.9
	15	10	14.1	14.1	35.2	-.7	4.1	6.8	21.4
	16	7	9.9	9.9	45.1	.0	3.9	4.0	19.9
	17	4	5.6	5.6	50.7	.9	3.1	1.2	15.9
	18	2	2.8	2.8	53.5	-.3	1.9	.0	7.0
	19	7	9.9	9.9	63.4	.2	3.1	4.2	16.9
	20	6	8.5	8.5	71.8	.3	3.0	3.8	17.1

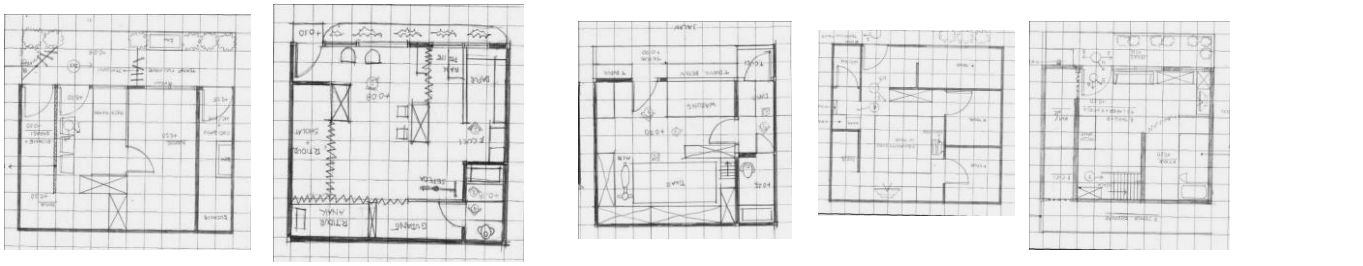
21	5	7.0	7.0	78.9	.1	3.2	1.4	14.1
22	6	8.5	8.5	87.3	-.6	3.4	2.8	16.9
23	2	2.8	2.8	90.1	.2	2.3	.0	8.7
24	2	2.8	2.8	93.0	.1	2.2	.0	8.7
25	1	1.4	1.4	94.4	.0	1.3	.0	4.2
28	2	2.8	2.8	97.2	.1	2.1	.0	8.5
29	1	1.4	1.4	98.6	-.1	1.4	.0	4.7
31	1	1.4	1.4	100.0	.2	1.5	.0	4.4
Total	71	100.0	100.0		.0	.0	100.0	100.0

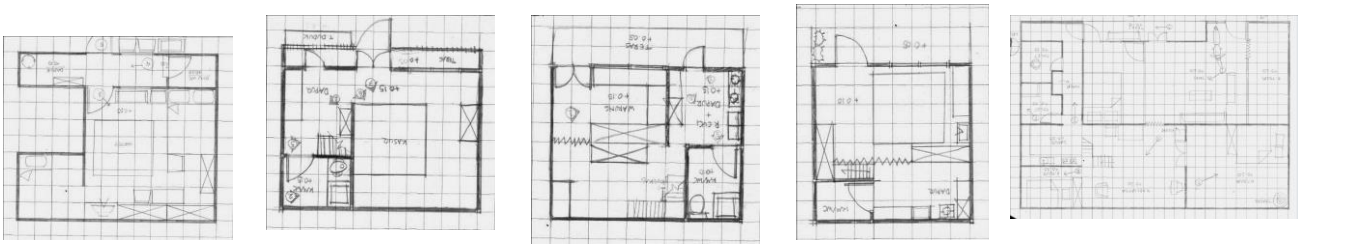
a. Unless otherwise noted, bootstrap results are based on 71 bootstrap samples

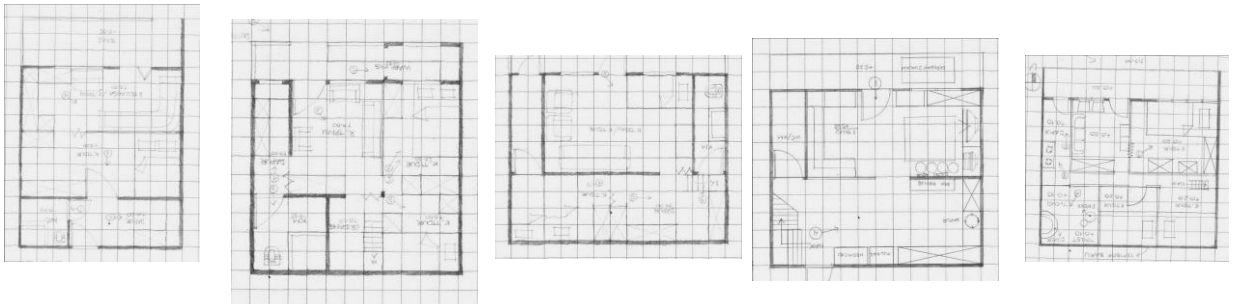
C. Sketches of Houses

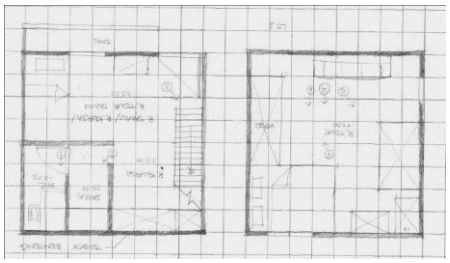
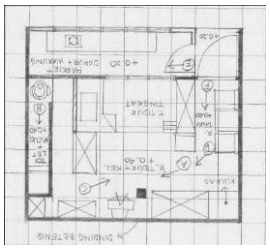
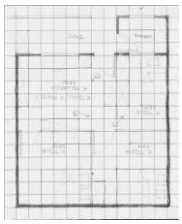
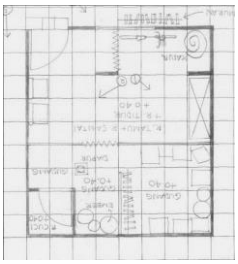


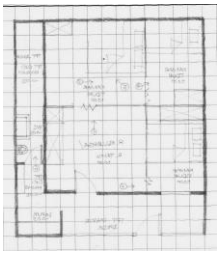
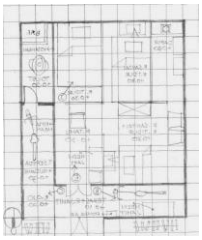
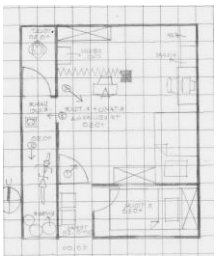
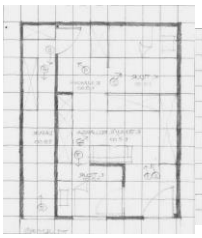
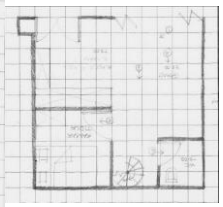


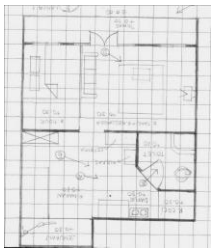
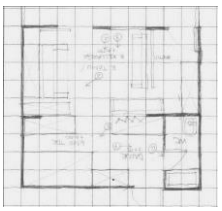
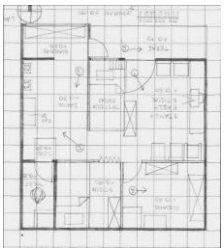
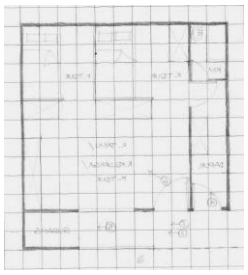
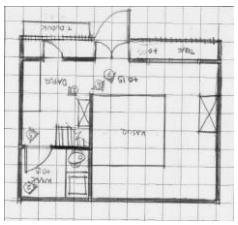


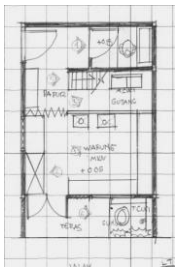
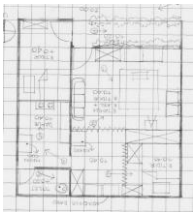
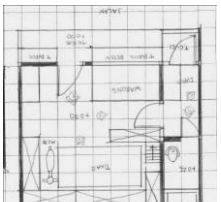
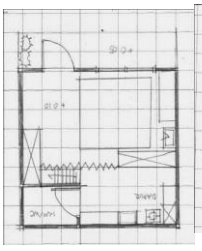
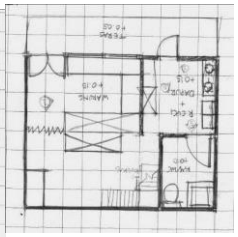


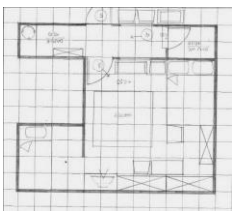
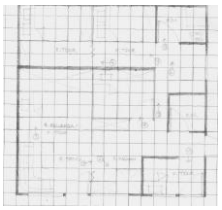


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